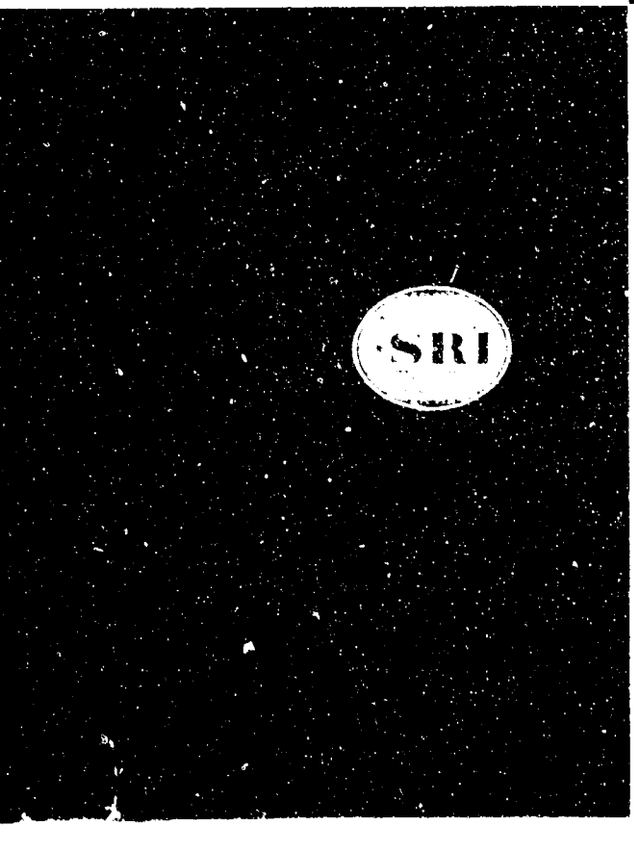
ORGANIZATIONAL DESIGN – AN EXPLORATORY STUDY

R & D
STUDIES
SERIES

AFOSR-67-2450
December 1967



HOWARD M. VOLLMER

in collaboration with
JOHN J. McAULIFFE
RICHARD I. HIRSHBERG
KENDALL D. MOLL

R & D
STUDIES
SERIES

ORGANIZATIONAL DESIGN- AN EXPLORATORY STUDY

December 1967

TECHNOLOGY
MANAGEMENT
PROGRAMS

By:

Howard M. Vollmer

in collaboration with

John J. McAuliffe
Richard I. Hirshberg
Kendall D. Moll

Technical Report
Phase I

SRI Project 6329

AFOSR-67-2450

Prepared for:

BEHAVIORAL SCIENCES DIVISION
AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
OFFICE OF AEROSPACE RESEARCH
UNITED STATES AIR FORCE
WASHINGTON, D.C.

Contract No. F44620-67-C-0039
Project No. 9779-02

STANFORD
RESEARCH
INSTITUTE

SRI

MENLO PARK
CALIFORNIA

PAGES _____

ARE

MISSING

IN

ORIGINAL

DOCUMENT

Other publications in the R&D STUDIES SERIES

ADAPTATIONS OF SCIENTISTS IN FIVE ORGANIZATIONS: A COMPARATIVE ANALYSIS
By: H. M. Vollmer, T. R. LaPorte, W. C. Pedersen, and P. A. Langton
May 1964

AN EXPLORATORY STUDY OF THE STRUCTURE AND DYNAMICS OF THE R&D INDUSTRY
By: Albert Shapero, Richard P. Howell, and James R. Tombaugh
June 1964

THE UTILIZATION OF SPACE-DERIVED TECHNOLOGY IN NON-SPACE APPLICATIONS
Part 1: Liquid Hydrogen
By: John G. Meitner
October 1964

APPLICATIONS OF THE BEHAVIORAL SCIENCES TO RESEARCH MANAGEMENT:
AN INITIAL STUDY IN THE OFFICE OF AEROSPACE RESEARCH
By: Howard M. Vollmer
November 1964

WORK ACTIVITIES AND ATTITUDES OF SCIENTISTS AND RESEARCH MANAGERS:
DATA FROM A NATIONAL SURVEY
By: Howard M. Vollmer
May 1965

THE STRUCTURE AND DYNAMICS OF THE DEFENSE R&D INDUSTRY:
THE LOS ANGELES AND BOSTON COMPLEXES
By: Albert Shapero, Richard P. Howell, and James R. Tombaugh
November 1965

THE ROLE AND CAREER DEVELOPMENT OF THE SCIENTIFIC AND ENGINEERING OFFICER
IN THE AIR FORCE
By: Howard M. Vollmer and William C. Pedersen
December 1965

THE ECONOMIC IMPACT OF DEFENSE R&D EXPENDITURES:
IN TERMS OF VALUE ADDED AND EMPLOYMENT GENERATED
By: Richard P. Howell, William N. Breswick, and Ernest D. Wenrick
February 1966

THE DEVELOPMENT OF A POTENTIAL DEFENSE R&D COMPLEX:
A STUDY OF MINNEAPOLIS-ST. PAUL
By: Kirk Draheim, Richard P. Howell, and Albert Shapero
July 1966

THE STRUCTURE AND DYNAMICS OF RESEARCH AND EXPLORATORY DEVELOPMENT
IN DEFENSE R&D INDUSTRY
By: Richard P. Howell and Albert Shapero
August 1966

INDIVIDUAL CHARACTERISTICS SIGNIFICANT TO SALARY
LEVELS OF ENGINEERS AND SCIENTISTS
By: Richard P. Howell, Martin Gorfinkel, and Dale Bent
October 1966

THE ROLE OF THE UNIVERSITY IN DEFENSE R&D
By: Albert Shapero, Kendall D. Moll, Robert A. Hemmes, and Richard P. Howell
December 1966

THE FEASIBILITY OF ANTICIPATING ECONOMIC AND SOCIAL CONSEQUENCES
OF A MAJOR TECHNOLOGICAL INNOVATION
By: James E. Hacke, Jr.
October 1967

A PRELIMINARY ANALYSIS OF INTER-SPECIALTY MOBILITY OF
TECHNICAL/PROFESSIONAL MANPOWER RESOURCES
By: Albert Shapero and John J. Bosley
October 1967

PREFACE

This is a report on Phase I of a three-year study being conducted by members of the Organization and Manpower Studies group of the Institute's Technology Management Programs. Since 1963, staff members of the Technology Management Programs have conducted research on: the structure, organization, and dynamics of the R&D industry; the social and economic impacts of R&D; the organization and management of R&D and other high technology activities; technology utilization and transfer; technological forecasting; scientific and technical manpower; science policy and the allocation of scientific and technical resources; and the development of systems analysis and other analytical methods useful in research on these topics. The results of this research are published or disseminated in the Institute's "R&D Studies Series," books, magazine and journal articles, and reprinted conference addresses.

"When, therefore, I considered all this, and the type of men who were administering the affairs of these organizations, with their policies and their practices...the more I advanced in years myself and the more difficult appeared to me the task of managing organizational affairs rightly.... Consequently, although I was filled with an ardent desire to participate in these organizations, when I considered all this and saw how things were shifting about in all directions, I became dizzy;... until finally, looking at all organizations which now exist, I perceived that one and all they are badly managed; for the state of their policies is such as to be almost incurable without some marvelous overhauling and good luck to boot. So I was led to the study and praise of the right philosophy and to the declaration that by it alone is one able to discern all forms of justice, both organizational and individual."

-- Plato, Autobiography

CONTENTS

CONTENTS

Part Two: Organizational Design Solutions

ILLUSTRATIONS

TABLES

Chapter 1

INTRODUCTION

Research Objectives

The overall objective of the study described herein is to develop research-derived criteria for the design of new forms of organization (or the planned change of existing organizations) to accomplish organizational goals effectively.

The research is being conducted in three one-year phases, with the following specific objectives, by phase:

I To specify preliminary design criteria on the basis of an analysis of organizational theory and prior experiences in organizational design.

II To test the effectiveness of these design criteria by applying them to ongoing organizational design activities and to modify the criteria as appropriate.

III To synthesize and publish the results of this investigation in a "Handbook of Organizational Design" appropriate for the use of managers in innovative forms of organization in government or private institutions.

This entire study is being sponsored by the Behavioral Sciences Division of the Air Force Office of Scientific Research. This is a report of Phase I of this study.

Background of the Research

In recent years, a number of publications have appeared that summarize organizational theory to date. However, only scant attention has been given to translating findings and conclusions of organizational theory into usable criteria for the design of new kinds of organizations, and especially for the design of changes in organizations that have been affected by new developments in technology. The few discussions of

organizational design to date have been exploratory in nature and have not been related systematically to research findings on organizational effectiveness in a manner that can be readily translated into useful design criteria.

Organizational design concerns the planning of task groups, role relationships among individuals and groups, physical settings considered appropriate for the accomplishment of particular organizational objectives, and related matters. An organizational designer is specifically related to an organizational researcher in much the same way that a design engineer is more generally related to a research scientist. All are concerned with theory, form, and technique. But the organizational designer is a practitioner and inventor who, in addition to drawing on his own creativity and intuition, should have available a fund of prior experience and principles derived from research on organizational effectiveness in seeking alternatives and combinations appropriate to the particular purposes of the organization, or segment of the organization, with which he is concerned.

However, those who design or redesign organizations usually have not had the results of organizational research readily available. They have been forced to do without detailed guides to principles underlying such matters as the probable effects of various social structures on organizational performance, the effects of the physical environment of the organization on the behavior of members, and ways of dealing with the problems that can be anticipated as a result of different relationships between the organization and its environment. As a result, the creation of new organizations and the planned change of existing organizations have been based largely on the limited personal experience of a planner or manager. In short, "organizational engineering" has been unable to make systematic use of principles derived from the study of organizational behavior.

A central purpose of the research described herein is to collect and codify existing design principles, to formulate new principles from existing knowledge of organizational behavior, and to present the results in a form that will be of maximum usefulness to those who have to plan or change organizations.

Awareness of the potentialities of organizational design (and the problems that arise when sound organizational design principles are not understood and followed) is increasing. It exists not only within the Air Force and other organizations within the Department of Defense, but also within many other organizations in government and in the private sector. While the deficiencies and difficulties that result from poorly

planned organizations are the staple fare in management training programs and in the academic training of organizational researchers, virtually no systematic, research based effort has been made to develop in the organizational field the equivalent of "design engineering," "preventive medicine," and "therapy" or to determine what kinds of skills, training, and experience are required for the effective practice of organizational design and planned change. This research is oriented toward these objectives.

Research Methods

In this first phase of study, a systems approach has been used to develop tentative design criteria and tools for organizational design. These have been derived primarily from:

1. A review of existing literature on (a) organizational theory and (b) organizational design based upon organizational theory.

2. Case study materials, interview comments, questionnaire survey data, and other materials from a prior five-year study of the adaptations of scientists and organizations, also sponsored by the Behavioral Sciences Division of the Air Force Office of Scientific Research from 1961 to 1966.

3. Interview and documentary materials from four case studies in organizational design, including analyses of the design of (a) fundamental research organizations, (b) emergency public services, (c) a manpower development program, and (d) a mass-production factory.

Acknowledgments

Howard M. Vollmer, as the principal investigator in this project, has been primarily responsible for writing this report, and therefore is responsible for any errors that may occur herein. In turn, the entire project has benefited greatly from the participation of John J. McAuliffe, Richard I. Hirshberg, and Kendall D. Moll and from comments from other members of the Institute's Organization and Manpower Studies group and of the larger Technology Management Programs. Mr. McAuliffe brought many years of industrial management experience to bear in collaborating with the senior author in all aspects of this research. Dr. Hirshberg was especially helpful in contributing the analysis on the underutilization of potential talent, with particular reference to women and Negroes,

reported in Chapter V. Mr. Moll and Dr. Hirshberg also contributed the material for Case B on Emergency Public Services in Chapter VIII. All three collaborators, Wesley L. Tennant, and Charlton R. Price have provided useful comments after reading a preliminary draft of the entire report. Gratitude is also extended to Mr. Price for some of the initial stimulus on which this research is based, as well as the original thinking underlying our analysis of the roles that organizational designers may take.

Chapter II

SUMMARY AND CONCLUSIONS

Summary

This report is divided into two main parts: Part One--"Major Organizational Problems" (Chapters III through VI); and Part Two--"Organizational Design Solutions" (Chapters VII through IX).

Chapter III on "Individuals and Organizations" discusses the methodological and ideological premises underlying this study. The basic methodological perspective is structural-functional, seeking to identify the major functions that organizations perform and then to determine the structural forms that permit these functions to be performed most effectively and efficiently. The basic ideological perspective is democratic, individual-centered, and pluralistic, assuming that all organizations are created to serve the needs of individuals, and not vice versa. It is further assumed that organizational design activities must seek to provide for the needs of both individuals and of organizations for a balance between security and challenge. A variety of "adaptation mechanisms" exist to allow individuals and organizations to achieve these basic needs simultaneously, but this balance in individual and organizational adaptation is most likely to be achieved where a special kind of function is provided for in an organizational structure--what may be called a "manpower utilization and development function."

Chapters IV and V provide evidence regarding the extent to which many modern organizations do not utilize manpower effectively--especially technical professional manpower. Chapter IV shows that most employing organizations "consume" technical talent without making adequate provisions for its regeneration. In the United States at present, there is evidence that about one in five engineers and one in fifteen physical scientists experience "technical obsolescence" as a serious problem in relation to their present job requirements. Moreover, there is additional evidence that as high as one-half of the engineers and one-fourth of the physical scientists in the United States have also lost the professional versatility that they once had, and that the extent of this loss tends to increase with age. These findings may be interpreted as indicators of the overutilization of technical professional talent in many organizational contexts.

Chapter V provides further data on the underutilization of both actual and potential talent in many organizations. There are indications that at least one-fifth of the engineers and one-tenth of the scientists in the United States experience underutilization of their abilities as a serious problem. Other data indicate that many companies tend to lose their most talented employees through turnover; at the same time these companies do not provide adequate opportunities for internal transfers of personnel. Furthermore, there are indications that many organizations could beneficially tap unused reservoirs of potential talent, especially among women and among Negroes.

Chapter VI discusses the ways in which modern organizations tend to stifle innovative activities. It is pointed out that the decentralized kind of organizational structure that is most conducive to the conception and proposal of innovations is not ordinarily the kind of organizational structure that is most conducive to the adoption and implementation of innovations. The latter is facilitated by a more centralized form of organizational authority. Therefore, it appears that a well-rounded program of generation and utilization of innovations requires an administrative structure that is mixed in form (i.e., is not too centralized nor too decentralized) and that permits the processing of (1) nonstandardized materials (physical objects, people, ideas, etc.) by nonstandardized methods and (2) standardized materials by standardized methods. Innovative activities need to be insulated from day-to-day diversions from noninnovative activities, but also need to be coupled with more routine activities so that useful innovations are speedily applied. Successful innovations also require regulatory provisions to protect novel thinking and the right to dissent from established ways of doing things, as well as a facilities layout that encourages an appropriate degree of both insulation and integration of innovative activities. Finally, as in the case of successful manpower development, it can be maintained that successful innovative activity is fostered by the establishment of separate organizational entities within a larger structure devoted to innovative and forward looking activities--e.g., fundamental research, long range planning, and technological forecasting.

In seeking ways to overcome the above problems in organizational structure and functioning we turn in Part Two to a description and analysis of the organizational design process in Chapter VII. This analysis indicates that the total process consists of (1) inputs of knowledge and skill from relevant theoretical and applied disciplines; (2) the core of the design process itself in which an organizational designer can act in the role of an "artist," an "expert consultant," a "technician," or a "professional," orienting his activities toward both operational and maintenance goals for the organization in the context of

a variety of environmental constraints; (3) outputs of design activities in the form of goal statements (charters), systems diagrams, organization charts, position descriptions, policy manuals, and facilities designs; and (4) the implementation and evaluation of design efforts. A summary evaluation of the state of the art of organizational design, based on the organizational design literature, indicates that there is a need for literature that brings together a systematic analysis of all phases of the organizational design process suitable for the guidance of organizational designers.

Chapter VIII provides an analysis of four case studies in terms of the components of the total design process and of questions derived therefrom. The cases deal with fundamental research organizations, emergency public services, a manpower development program, and a mass production factory. Analysis of these four cases suggests the hypotheses that (1) organizations that are "technologically congruent" will be easier to design than those that are not; (2) situations in which the type of role that the designer takes is not clearly understood and accepted by the client, the client organization, and/or the designer are likely to be accompanied by major problems in the design process; and (3) situations in which there is a smooth continuity between all phases of the entire design process, from initial inputs to testing and evaluation of the design effort, are more likely to lead to successful design efforts.

Conclusions

Drawing on the findings and discussions in these previous chapters, Chapter IX presents tentative design criteria relevant to (1) the role of the designer, (2) major organizational variables to take into account in the design process, and (3) evaluative indicators regarding the effectiveness of design efforts. The designer role criteria deal with:

- The increasing use of organizational design specialists
- The benefits to be derived from effective use of these specialists
- The need for design specialists to be well grounded in relevant background disciplines
- The need for design specialists to work in a close collaborative relationship with clients
- The need for the role of the designer to be accepted by other significant members of the client organization, as well as the immediate client representative

- The need for the designer's role to be clear and accepted in all phases of the entire design process.

In turn, the organizational variable criteria relate to the extent to which organizational designs (or redesigns) provide for:

- A specific manpower development function in the organizational structure
- A specific innovation producing function in the organizational structure
- A form of technology that is most appropriate to the goals and environmental constraints of the organization
- Organizational structure and patterns of functioning (hierarchy of authority, division of labor, formal and informal communications, and layout of facilities) that are appropriate to organizational goals, forms of technology, and environmental constraints.

Criteria that may be used to evaluate organizational design activities can be found in:

- Documentary outputs of the organizational design process (goal statements, systems diagrams, organization charts, position descriptions, policy manuals, facilities designs, etc.)
- Interview comments of designers, clients, and members of the client organization
- Other data on productivity, profit and loss, attitude and opinion surveys, etc.

In addition, several kinds of analytical tools developed or elaborated on in the course of this exploratory study are suggested as aids in future organizational design activities:

- Organizational design process analysis
- Organizational design role analysis
- Technological structure-function analysis
- Adaptation mechanisms analysis

- Manpower development analysis
- Facility/function analysis

The various design criteria and the analytic tools are to be developed in more detail and tested in the subsequent phase of this research.

PART ONE: MAJOR ORGANIZATIONAL PROBLEMS

Chapter III

INDIVIDUALS AND ORGANIZATIONS

Our approach to the development of research-based criteria for the design of organizations is built on two basic perspectives. One is methodological; the other is ideological. The methodological perspective is essentially structural-functional.* It seeks (1) to identify the basic functions that organizations perform, both in overt or formal terms and in covert or informal terms, and then (2) to determine the structural forms (i.e., kinds of relations between individual and group roles) that permit these functions to be performed most effectively and most efficiently.† However, as they become "institutionalized," we recognize that organizations tend to develop "a life of their own"; they develop mechanisms to perpetuate themselves; original goals and functions tend to become displaced by new goals and functions; and the needs and interests of participants tend to become bent by, if not subordinated to, organizational ends.‡

At the same time, the ideological perspective taken herein is essentially democratic, individual-centered, and pluralistic. It is based on the assumption that all formal organizations, including the nation-state, are created to serve the needs of individuals, and not vice versa. In detail, it is assumed that individual needs will be met best through participation in a variety of organized group activities (i.e., in a society with a pluralistic power structure, rather than a monolithic state) and that organized group activities must be ultimately (though not necessarily immediately) responsive to the influence and control of participants to

---

* See H. M. Vollmer, "Structural-Functional Analysis as a Method," in R. V. Bowers, ed., Studies on Behavior in Organizations (Athens, Ga.: University of Georgia Press, 1966).

† The concepts of organizational "effectiveness" and "efficiency" were most explicitly formulated by Barnard in The Functions of the Executive (Cambridge, Mass.: Harvard University Press, 1938).

‡ These are basic propositions in the "natural systems" theory of organization, as described in A. W. Gouldner, "Organizational Analysis," in R. K. Merton, L. Broom, and L. S. Cottrell, Jr., eds., Sociology Today (New York: Basic Books, 1959); developed fully in P. Selznick, Leadership in Administration (Evanston, Ill.: Row Peterson, 1957).

assure that these activities continue to meet individual needs. We assume that freedom to develop individual capabilities to the fullest is functionally dependent on order in society (i.e., participation in organized groups); in fact, we recognize that freedom and order are mutually interdependent. However, one's ideological perspective determines whether he takes "freedom" or "order" to be the ultimate goal of his analysis. Here, order is viewed as the servant of freedom--the means to the ultimate end of individual self-expression and self-development--rather than vice versa.

We could use this perspective to analyze the relations of individuals to any one of the multitude of organizations in which an individual may participate in modern society, including his family, his professional association or trade union, various voluntary associations, the church, or the state. However, we have chosen to focus on the relations of individuals to organizations that employ his labor--the institutions in which he works in return for some kind of wage, salary, or fee remuneration. It is in such institutional contexts that we sometimes find the widest gaps between individual needs and organizational interests, perhaps in part because employing organizations can claim that they have discharged their legitimate obligations to employees as soon as they have delivered their paychecks (which are interestingly enough termed "compensation" for doing things that individuals might prefer not to do if they did not need the money to survive in a cash economy). Yet individuals are not completely mollified by monetary compensation for their labor; the industrial relations and personnel management literature is full of evidence of conflicts between employees and management that ultimately relate to many nonmonetary aspects.*

What are the fundamental bases for management-employee conflict in modern society? Could organizations be designed to alleviate, if not eliminate, such conflicts? In asking such questions, it is recognized that in American society, employing enterprises are ordinarily formed not to satisfy the needs and interests of their employees, but rather to produce some product or service required by customers and to do this with a reasonable degree of profit for owners. Employing organizations must

---

* For discussions of conflict in industrial relations, see A. Kornhauser, R. Dubin, and A. M. Ross, eds., Industrial Conflict, (New York: McGraw-Hill, 1954); in trade union organization, see S. M. Lipset, M. A. Trow, and J. S. Coleman, Union Democracy, (Glencoe, Ill.: Free Press, 1956); in industrial organization, see Argyris, Integrating the Individual and the Organization, (New York: Wiley, 1964); and in research organizations, see Kornhauser, Scientists in Industry: Conflict and Adaptation, (Berkeley and Los Angeles: University of California Press, 1962).

function in terms of several significant interest groups, including customers, owners (or financiers), and the general public, as well as employee participants. To serve all these interests at once may not permit the "optimizing" of any one set of interests; it may only allow the minimal "satisficing" of the needs of each group.* We recognize that such minimum level compromise may turn out to be the only possible answer, but we will not now accept this answer as fact without much more study. We want to find out if it may not be possible to design some kinds of employing organizations, at least, in a better way than they are designed at present--so that they can improve the degree to which they satisfy employee needs along with those of other interest groups, even though they may not optimally satisfy everyone's needs in some absolute sense. We believe that inquiry into this matter is essential in the kind of society in which many of us live today in modern America--an affluent majority society superimposed on an impoverished and deprived minority society and a society in which technological sophistication appears to be rapidly outstripping organizational inventiveness.

The Needs of the Individual

So far, we have mentioned individual needs without being specific on what we mean. When we try to get specific about this topic, we immediately run into controversy among knowledgeable men in relevant scholarly disciplines. McDougall, an early social psychologist, postulated that human beings have over half a hundred needs (instincts) to satisfy in some societal context.† W. I. Thomas, an early American sociologist, was more parsimonious in his approach, and spoke of four "fundamental wishes": for security, new experience, recognition, and mastery.‡ Sigmund Freud, the father of modern psychoanalysis, built a structure of analysis based largely on the human drive of love (eros).§ A social psychologist of considerable influence in recent years, A. H. Maslow, has written of a "hierarchy of needs," beginning with basic psysiological

---

* For a discussion of "satisficing" criteria, see J. G. March and H. A. Simon, Organizations (New York: Wiley, 1958), pp. 140-1.

† See W. McDougall, Introduction to Social Psychology (London: Methuen, 1908).

‡ See W. I. Thomas, The Polish Peasant in Europe and America (New York: Knopf, 1918-21), and The Unadjusted Girl (Boston: Little, Brown & Co., 1923).

§ See S. Freud, The Basic Writings of Sigmund Freud, trans. & ed. by A. A. Brill (New York: Random House Modern Library, 1938).

needs that must be satisfied before the individual can turn to the satisfaction of "higher needs" such as safety, belongingness and love, esteem, and self-actualization, in that order.*

Whether such a hierarchy of needs exists and in the order asserted by Maslow is a subject of professional discussion and further research. The available evidence to date does indicate that human beings require some kind of a balance between "security" and "challenge" in their total life experience to develop fully their potential capabilities, assuming that all of the "needs" postulated by various authorities could be subsumed within one or the other (or both) of these two concepts. The need for security, both in a physiological and a psychological sense, was explicitly recognized by Thomas and is certainly closely related to Maslow's "lower needs," as well as Freud's emphasis on eros and its evolution out of early parental relationships. But man also seeks something more, as Goethe indicated when he had his Faust disprove the claim that "Man's active nature, flagging, seeks too soon the level." By nature, man needs challenge and seeks stimulation in his environment.

This conclusion squares with Maslow's recognition of the importance of self-actualization; Barker, Dembo, and Lewin's studies showing that a certain amount of tension and frustration increases creativity in children; Allport's finding that tension enhancement can be characteristic of healthy individuals; Bruner's findings on the value of growth strivings; Fromm's arguments that the concept of freedom from responsibilities should be changed to freedom to be more responsible; Frankl's conclusions that mental health is based on a certain degree of tension; Wolf's contention that modern society has too much emphasis on security and dependence; Schwartz, Jenusaitis, and Stark's findings that healthy individuals look for responsibility and develop challenges; Henry's findings that more competent executives are more likely to be in conflict and preoccupied; and Haire's conclusion that men may need responsibilities that outweigh their authority and that the attempt to balance them may lead

---

* See A. H. Maslow, Motivation and Personality (New York: Harper, 1954).

to increased costs both for the organization and for the individual.* After extensive studies of organizational conditions that contribute to productivity among scientists, Pelz also came to the general conclusion that productivity is greatest under conditions that provide a proper balance between security and challenge.†

Therefore, a variety of scholars using a variety of approaches have supported the conclusion that individuals function best in an organizational environment that provides sources of stability and confidence (security) along with sources of disruption or intellectual conflict (challenge). Either condition without the other balancing condition is likely to lead to dissatisfaction or decreased productivity, at a minimum, and perhaps to anxiety and mental illness if the unbalanced condition continues.

The Needs of the Organization

So much for the needs of individuals. What about the needs of an employing organization? Here we recall the basic proposition that organizations tend to develop a "life of their own." In the course of this life, they develop organizational needs.

It appears that organizations develop needs that are quite analogous to the needs of individuals--again, the need for security and the need for challenge. The need for organizational security is apparent in the

---

* See R. Barker, T. Dembo, and K. Lewin, "Frustration and Regression," University of Iowa Studies in Child Welfare, vol. 18, no. 1, 1941; G. W. Allport, "The Trend in Motivational Theory," American Journal of Orthopsychiatry, vol. 23 (January 1953), pp. 107-19; J. Bruner, "The Act of Discovery," Harvard Educational Review, vol. 31 (Winter 1961), pp. 26-28; E. Fromm, The Art of Loving (New York: Harper, 1956); V. E. Frankl, From Death Camp to Existentialism (Boston: Beacon Press, 1959), and "Basic Concepts of Logotherapy," Journal of Existential Psychiatry, vol. 3 (1962), pp. 113-4; W. Wolf, "Wider Horizons in Psychotherapy," American Journal of Psychotherapy, vol. 16 (January 1962), pp. 124-49; M. M. Schwartz, E. Jenusaitis, and H. Stark, "Motivational Factors among Supervisors in the Utility Industry," Personnel Psychology, vol. 16 (Spring 1963), pp. 45-53; W. E. Henry, "Conflict, Age, and the Executive," Business Topics, vol. 9, no. 2 (Spring 1961), pp. 15-25; and M. Haire, "The Concept of Power and the Concept of Man," in G. B. Strother, ed., Social Science Approaches to Business Behavior (Homewood, Ill.: Dorsey-Irwin Press, 1962), p. 171.

† See D. C. Pelz, "Creative Tensions in the Research and Development Climate," Science, vol. 157 (1967), pp. 160-5.

tendency for all organizations to develop ways and means to protect themselves from external and internal threat and to perpetuate themselves over time. Max Weber's whole theory of the bureaucratization of charismatic social movements stresses this tendency.* More recently, Philip Selznick has been an especially perceptive student of the way in which organizations develop a "concern for self-maintenance" as a part of the process of "institutionalization." In this regard, Selznick has written:

> The transformation of expendable technical organizations into institutions is marked by a concern for self-maintenance. A living association blends technical aims and procedures with personal desires and group interests. As a result, various elements in the association have a stake in its continued existence. Moreover, the aims of the organization may require a certain permanence and stability. There is a need to accommodate internal interests and adapt to outside forces, in order to maintain the organization as a "going concern," minimize risks, and achieve long-run as well as short-run objectives. An important sign of this development is that the leaders become security-conscious and are often willing to sacrifice quick returns for the sake of stability.†

As universal as this tendency toward self-maintenance may be, it is also true that even the most conservative organizations ultimately generate forces that work toward innovation and change. The U.S. military services have produced a number of Billy Mitchells and Hyman Rickovers; and even as ancient, venerable, and bureaucratic an organization as the Roman Catholic Church produced a John XXIII. Such individuals are not mere accidents or anomalies within their particular organizational structures, but are the result of "conditions of challenge" that exist in every organization to counterbalance conservative tendencies, even though these innovative tendencies may be submerged literally for centuries. Indeed, Chester Barnard maintained--and Philip Selznick elaborated the thesis--that it is the principal function of executives to provide innovative leadership; to be the designers and shapers of new organizational goals, rather than the mere administrators of previously determined policy.

---

* See M. Weber, From Max Weber: Essays in Sociology (New York: Oxford University Press, 1946); M. Weber, The Theory of Social and Economic Organization, trans. by A. M. Henderson and T. Parsons (Glencoe, Ill.: Free Press, 1947).

† See P. Selznick, Leadership In Administration, pp. 20-1.

Leadership at the highest levels of organizational structure is not the only source of challenge leading to change, however, Functional specialization within an organization can also become a source of innovation. In my own research, I have found, for example, that personnel offices within business corporations, which were originally established to help "manage" the employment and utilization of employees in the interests of their employer, have sometimes become strong supporters of concepts of "employee rights" vis-a-vis the employing organization.* Similarly, organizationally separated corporate research laboratories appear to provide an environment for scientific and technical innovation in business corporations in ways that do not occur where research laboratories are integrated into operating divisions.† In fact, the large-scale employment of research scientists can include the development of entrepreneurial roles and professional-client relationships that support innovation in a variety of organizational contexts.‡

Charles Perrow pointed out recently that it is useful to classify organizations along two dimensions: one is the extent to which organizations process standardized or nonstandardized materials (human, physical, or symbolic items); the other is the extent to which persons in organizational roles use standardized or nonstandardized search methods to solve organizational problems in their material processing activities.§ From Perrow's analysis, it is possible to derive the proposition that organizational contexts in which nonstandardized materials and nonstandardized methods predominate are most likely to produce innovations in products and that those with standardized materials and methods are likely to be most conservative, with two other "mixed" types somewhere in between. Nevertheless, one can also maintain that even the most standardized kinds

---

* See H. M. Vollmer and P. J. McGillivray, "Personnel Offices and the Institutionalization of Employee Rights," Pacific Sociological Review, vol. 3 (Spring 1960), pp. 29-34.

† See H. M. Vollmer, ed., The Fundamental Research Activity in a Technology-Dependent Organization (Washington, D. C.: Air Force Office of Scientific Research, 1965), appendix, "Data on the Organizational Separation of Research from Development," pp. 93-100.

‡ See H. M. Vollmer and D. L. Mills, eds., Professionalization (Englewood Cliffs, N. J.: Prentice-Hall, 1966), "Professional Adaptation to Organizations," pp. 275-282.

§ See C. Perrow, "A Framework for the Comparative Analysis of Organizations," American Sociological Review, vol. 32 (1967), pp. 194-208.

of organizational environments might be expected to produce innovations under radically changed environmental circumstances, as we can easily see in many examples.*

Therefore, Perrow's distinctions refer to differences in degree, rather than to irreversible differences in kind. All organizations have an inherent potential to respond to challenge, engage in problem solving, and adapt to change, even though the current balance between self-maintenance tendencies and innovative tendencies may vary markedly in given cases.

The key proposition in our summary analysis of the organizational conditions that appear to be most conducive to constructive (effectively adaptive) change is as follows: that this kind of change is most likely to occur under conditions of balance between problem stimuli (i.e., challenge) and self-maintenance considerations (i.e., security). This idea is foreshadowed in March and Simon's summary of theory on this topic:

> The hypotheses listed thus far attribute the parenthood of invention primarily to necessity and secondarily to opportunity. There is another common hypothesis, not derivable from these postulates, that innovation will be most rapid and vigorous when the "stress" on the organization is neither too high nor too low. By stress is meant the discrepancy between the level of aspiration and the level of achievement. According to this hypothesis, if achievement too easily exceeds aspiration, apathy results; if aspiration is very much above achievement, frustration or desperation result, with consequent stereotypy. In the first case, there is no motivation for innovation; in the second case, neurotic reactions interfere with effective innovation. Optimal "stress" results when the carrot is just a little way ahead of the donkey -- when aspirations exceed achievement by a small amount.
>
> The concept of optimal stress is central to Toynbee's theories of social progress. The same hypothesis is employed frequently in educational theory, in determining the difficulty of the successive tasks with which a learner should be confronted.†

---

* It will be pointed out in Chapter VI, however, that the kind of organizational environment in which innovations are most likely to be conceived is not necessarily the kind in which innovations are likely to be accepted and implemented.

† See March and Simon, op. cit., p. 184.

It is in accord with this theory that perceptive research managers in industrial and government contexts have claimed that "good research must be insulated, but not isolated" from other corporate activities.* Organizations, like individuals, require a balance between security and challenge.

Adaptation Mechanisms and Need Balance

We can view the interaction of individuals and organizations as an interplay between two systems--a social system and a personality system--each of which requires a balance between security and challenge.† In this interplay, what happens is that each system develops behavioral mechanisms whereby it attempts to modify the behavior of the other system (the organization or the individual) to fit its own particular pattern of balance between security and challenge.

Many of these mechanisms were analyzed in detail in our previous studies of scientists and organizations, with particular reference to a variety of different kinds of research organizations.‡ In these studies, it was found that research organizations attempt to obtain the kinds of research scientists that are presumably best suited to the needs of the employing organization through the mechanism of recruitment, and conversely, to get rid of unsuitable employees through displacement (dismissal, forced layoff, early retirement, etc.). Once having obtained these individuals, research organizations then attempt to influence individual productivity through the manipulation of a variety of both monetary and nonmonetary incentives. Finally, over time during the careers of employees in particular organizational contexts, the process of organizational socialization acts in a variety of ways to reshape individual interests and activities in terms of organizational requirements.

In contrast, it was also found that scientific employees use several important mechanisms to attempt to reshape their organizational environments into situations more amenable to their own interests. These include

---

* See J. E. Goldman, "Basic Research in Industry," International Science and Technology vol. 7 (December 1964), p. 44.

† Fundamental considerations in the interaction between social systems and personality systems are discussed in detail in T. Parsons and E. A. Shils, eds., Toward a General Theory of Action (Cambridge, Mass.: Harvard University Press, 1954).

‡ See H. M. Vollmer, Adaptations of Scientists and Organizations (publication forthcoming).

the process of research entrepreneurship, whereby more highly professionalized scientists establish client relationships with other individuals or groups, cutting across formal administrative hierarchies; hedging and bootlegging, whereby scientists manipulate formal work requirements on research projects to allow the researchers to work on topics of their own (but not necessarily their client's) direct interest; collaboration, whereby work of mutual interest is more effectively and efficiently done by two or more individuals than would be possible for a single individual, again in patterns of relationships that cut across formal administrative divisions; and status advancement, whereby scientific employees enter managerial positions where significant decisions regarding organizational goals and policies are established and where these can be reshaped.

Mechanisms of mutual adaptation like these allow "the work to get done" in any organizational context, but they also extract a price. At best, the price may be simply a certain degree of inefficiency in operations, resulting from the compromises that may have to be made in recognition of the fact that the needs of neither system--the organizational (social) nor the individual (personality)--can be optimized, but can only be minimally satisfied. At worst, organizations may operate so that individuals are recruited, socialized, and induced to perform in ways that "overutilize" or "underutilize" individual talent, without providing adequate opportunity for the individual to develop or regenerate talent to his full potential. Similarly, individual entrepreneurship, bootlegging, collaboration, and status advancement can all occur in ways that "benefit" a few to the detriment of many. Where such problems of adaptation occur, individuals can be expected to become insecure, apathetic, or both, and moreover, organizational capabilities for innovation can be expected to wither and die.

The Manpower Utilization and Development Function

Unless organizations have a particular individual--or better, a unit or department--charged with the responsibility for continually investigating and facilitating the proper adaptation of individuals and organizations, it will not be accomplished. As indicated earlier, some previous research has shown that personnel offices sometimes take on this responsibility,* but this is not generally the case. In many

---

* See Vollmer and McGillivray, op. cit.

companies, personnel offices are concerned mostly with hiring and personnel record keeping.* After an employee is hired his further growth and development is subject to the needs and viewpoints of his immediate line management. Unfortunately, both for the individual and for the larger organization, the viewpoints of lower and middle level management regarding manpower utilization and development are often limited to the framework of needs of the immediate department or employing group. Therefore, it is often very difficult for employees to obtain transfers to other departments, for example, where their personal interests might be better fulfilled and where they might have more opportunity for personal growth. It is usually easier to leave an organization than to obtain an internal transfer.

The Bell Telephone Laboratories is one of the few industrial organizations that has instituted a special "Utilization and Placement Function" within its central Personnel Division, whereby the effective placement of technical professional personnel may be reviewed periodically and internal transfers be facilitated. After some five years of study and experience with this function, the Bell Laboratories management has concluded that the following objectives have been achieved by means of this organizational unit:

1. To aid in the early detection of placement problems.

2. To coordinate efforts toward a solution of placement problems.

3. To facilitate communication between technical professional personnel and management on job interests and assignments.

4. To provide an impartial negotiator in transfer situations.

5. To demonstrate management's commitment to optimal placement of people.†

---

* For a study showing that personnel departments seldom play innovative roles at present, see D. E. McFarland, "Organization Design, Personnel Administration, and Administrative Expectations," (a paper delivered at the 14th International Meeting of the Institute of Management Sciences, Mexico City, Mexico, August 26, 1967.)

† See F. D. Leamer, "How a Company Minimizes Turnover and Maximizes Efficiency as Applied to Technical Personnel," in Joint Engineering Management Conference, Managing Engineering Manpower (New York: American Society of Mechanical Engineers, 1967), pp. 128-34.

Organizational arrangements of this type tend to offset either the overutilization or underutilization of talent in specific segments of larger organizations. However, the fact that there is much still to be done in this regard in U.S. industry and most employing organizations is demonstrated in the following two chapters.

Chapter IV

ORGANIZATIONS AS CONSUMERS OF TALENT

In modern society only one category of organizations--educational institutions--can be considered to be predominantly producers of talent, that is, producers of the kinds of knowledge and skills that are necessary to function in most institutional structures in a high technology society. On the other hand, all organizations (including educational institutions) can be considered to be consumers of talent--i.e., they can use up knowledge and skills at a faster pace than they provide for its regeneration. Although practically all organizations that employ people provide at least on-the-job training for their employees (thereby contributing to the maintenance or renewal of present talent, if not necessarily to the production of new talent), and increasing numbers of organizations are providing some kinds of more formalized updating programs, most employing organizations still consume more talent than they produce among sizable proportions of their technical professional workforces. In the face of the "knowledge explosion" and related technological changes, job requirements also change, and many individuals are unable to keep up with these changes. Over time, their knowledge and skills have become "technically obsolete" in relation to the changing requirements of their current jobs. Others have become so "overspecialized" in their present jobs that they are unable to transfer into new lines of work, take on managerial responsibilities, or maintain the level of general knowledge and skills required among competent members of professional disciplines.

The argument is presented here that--to meet the social and technological challenges of the future--employing organizations will have to take on even more responsibility for producing talent (or regenerating it) than has been the case in the past. To keep pace with technological changes, individual members of society must be increasingly involved in a lifelong process of education. The idea prevailing for centuries of a distinction between "a time to learn" and "a time to work" or to apply what one has learned is less appropriate in the lives of individuals in modern society. More and more, learning and work must become continuously integrated over practically the entire life span of the individual. Some schools are beginning to recognize the consequences of this idea, by instituting combined work-and-study programs. On the other hand, employing

organizations are having to recognize the consequences of this idea by placing more emphasis on on-the-job and in-house training programs, as well as outside arrangements with universities for adult continuing education programs. But most employing organizations have some distance to go before the extent to which they use up present talent is offset by the extent to which they play a significant role in the regeneration of new talent.

Observations on Manpower Obsolescence

Overspecialization and technical manpower obsolescence as a national concern has been reflected in the speeches and writings of leading authorities. For example, John W. Gardner, Secretary of the U.S. Department of Health, Education, and Welfare, has written:

> Clearly we cannot do away with specialization, nor would we wish to. But in the modern world it has extended far beyond anything we knew in the past. And, unfortunately, there are many tasks that can be effectively performed only by men and women who have retained some capacity to function as generalists--leadership and management, certain kinds of innovation, communication and teaching and many of the responsibilities of child-rearing and of citizenship. Furthermore, the extremely specialized man may lose the adaptability so essential in a changing world. He may be unable to reorient himself when technological changes make his specialty obsolete.
>
> Note that it is not a question of doing away with the specialist. It is a question of retaining some capacity of function as a generalist, and the capacity to shift to new specialties as circumstances require.
>
> In human societies there is no reason whatever why the specialist should not retain the capacity to function as a generalist. Whether he actually does so depends partly on his motivation, partly on the manner in which he was educated and partly on the nature of the organization or society in which his abilities mature.* (Emphasis added.)

---

* See J. W. Gardner, Self-Renewal (New York: Harper and Row, 1964), pp. 24-5.

William W. Seifert, Assistant Dean of Engineering of the Massachusetts Institute of Technology, has described several different aspects of this general problem area in the following terms:

> Currently, R&D activities are attracting a major fraction of the best technical people in the country. Nevertheless, companies in which the technical staff is concerned almost wholly with such activities are voicing growing concern over the fact that even their best engineers find themselves in a technical rut in just a few years. More effective means must be found for assisting practicing engineers in learning to take full advantage of the latest advances of technology.
>
> For engineers concerned primarily with applying the findings of R&D to improve goods and services and thereby profits for the company, the problem is in a sense even more difficult. As research activities have grown, a widening gulf has developed between the research engineer and the applications engineer, with the former finding less time to devote to applications problems, and the applications engineer finding it increasingly difficult to keep himself even vaguely aware of research activities that might have considerable impact on his immediate problems. As a result, industry suffers, and many practicing engineers fail to derive the satisfaction they would by performing to the full extent of their capabilities.
>
> The technical manager also is caught in this dilemma since it is unreasonable to expect him to make the best decisions if he is unable to understand and appraise the work being carried on by his own staff, let alone be in a position to take an aggressive part in introducing new technology.*

A special committee of eminent scientists and science administrators, headed by James R. Killian, Jr., recommended in a report to the President in 1964 that industrial organizations should pay particular attention to

---

* W. W. Seifert, "The Prevention and Cure of Obsolescence in Scientific and Technical Personnel," Research Management, Vol. 7 (1964), p. 145.

providing an environment that encourages "highly talented manpower" to keep their talent up to date:

> Industry should provide opportunities and encouragement for its scientists and engineers to keep abreast of new developments in their professional specialties, and in some cases to enter new fields. Steps that may be taken to that end include provision of free time for basic research, leaves of absence for the purposes of broadening and updating knowledge, and subsidization of retraining in universities.
>
> . . . certainly employing institutions that use up high-talented manpower on narrowly focused tasks, without providing for the replenishment and expansion of skill and knowledge, are shirking a vital responsibility. It is important that industrial management be as much concerned with building the capacities of people as with assigning them to productive tasks. Although many companies do invest substantially in professional improvement of scientists and engineers, more would find it profitable to do so.*

Industrial managers and executives, especially in research and development organizations, show many signs of concern with the problem of technical manpower obsolescence and with the responsibility of their organizations to help employees overcome it. This has been reflected in the considerable number of conferences among industrial representatives that have been held to discuss problems of technical manpower obsolescence and what to do about it. These meetings have not been limited to R&D organizations, or even to what are commonly thought of as "high technology" industries. For example, a discussion on "The Continued Development of Technical Personnel--Prevention of Obsolescence" was held by the Industrial Research Institute in 1964, and included 55 participants from major companies in steel, chemical, petroleum, pharmaceutical, electronic, electromechanical, rubber, textile, photographic, food, and other industries. The general conclusion of the participants was stated as follows: "The prime responsibility for continued development of the professional man lies with the man himself, (but) of scarcely less importance is the organization to which he owes his loyalty and which in

---

* Committee on Utilization of Scientific and Engineering Manpower, Toward Better Utilization of Scientific and Engineering Talent (Washington, D.C., National Academy of Sciences, 1964), p. 26.

turn gives appropriate recognition to the man who succeeds in keeping abreast of his field of work."* A report of another conference called by Dr. M. Scott Myers, Manager of Management Research and Development, Texas Instruments, Inc., involving 25 participants from a variety of industrial, educational, and research organizations, concluded that:

> . . . individuals per se do not become obsolete, but activities or functions of individuals can become obsolete in relation to the requirements of their surroundings. In addition, many felt that . . . the organizational environment itself can become obsolete. This kind of organizational obsolescence can relate to the structure in which people work -- its goals, its means of meeting its goals, its products or services, its selection of obsolete personnel, and its effect on mobility of personnel.†

Educators and educational institutions, which must operate at the forefront of technical advances, can experience obsolescence too. Thus W. R. Marshall, Jr., President of the A.I.Ch.E. and Associate Dean of the College of Engineering of the University of Wisconsin has written:

> . . . the practicing engineer is not alone in his problem of keeping abreast of new knowledge. The engineering educator is in an equally difficult task, possibly more difficult in some respects because of the expectation that he is the person who should know about all new scientific developments. It is not strange, therefore, that colleges of engineering have undertaken programs to keep their faculty up to date and abreast of new advances. It was the recognition of the need for continuing faculty training that prompted the Ford Foundation to grant substantial sums of money to aid in the development of engineering faculties.‡

---

* See Industrial Research Institute, "Continued Development of Technical Personnel--Prevention of Obsolescence," Research Management, vol. 8 (1965), p. 167.

† See J. G. Roney, Jr., Report on First Conference on Occupational Obsolescence (Menlo Park, Calif.: Stanford Research Institute, 1966), p. 7.

‡ See W. R. Marshall, Jr., "Educators Get Obsolete Too," Chemical Engineering Progress, vol. 59 (October, 1963), p. 19.

The Experience of Manpower Obsolescence

Technical manpower obsolescence is not just a phrase or faddish concern among educators and managers in current times; it is a real experience among practicing engineers, scientists, and other technical professional personnel. Such experience has been reflected frequently in comments made during previous studies of scientists and engineers in a variety of organizational environments conducted by the author. Following are some typical comments from these studies:

> I have spent more than 16 years in industry and I am amazed at the ignorance of many of the senior research engineers here to the advances that have been made in their very own fields out in industry. To maintain the high prestige that this laboratory has, it must insist that its personnel read the current literature and attend professional meetings more frequently. (Senior research engineer, university research laboratory.)

> This organization should have an organized plan to combat engineering obsolescence. This could be worked out with local universities and partly paid for by the organization. (Research scientist, nuclear research laboratory in industry.)

> Time on the job here does not enhance nor improve an individual's ability or capability, if it is in the same position over a period of years. Instead, that individual stagnates, and subsequently so does the company. Any organization must recognize talent and utilize it to the fullest in order to survive in today's demanding economy. (Design engineer, nuclear engineering department in industry.)

> We should develop reasonable steps to transfer unsuitable people to non-research organizations within government. Most of these people have invested themselves heavily in government service and should <u>not</u> be hurt by removal. They have, however, been bypassed by changes in technology and emphasis in the organization here, and are now simply taking up valuable space. (Research scientist, government laboratory.)

> I have been unable to devote as much time as I would have liked to keeping abreast of the new developments in my own particular field. I believe that more seminars among the research personnel could help remedy this. (Research engineer, nonprofit research organization.)

> Despite the several educational programs available to our employees, I don't believe enough real encouragement is being offered the employee to improve himself professionally. Another research organization, for example, similar in many respects to ours, can afford a "sabbatical" plan whereby their employees can acquire higher degrees on a full-time basis while being paid a stipulated percentage of their salary. We tend to operate on more of an ad hoc basis. (Systems analyst, nonprofit research organization.)

Such experiences are expressed by staff members at different levels of education and occupational requirements. Thus, for example, a laboratory technician stated:

> In regard to personnel assignments, I would like to see some sort of rotational plan among the technicians, engineering aids, and engineering assistants whereby they would work in different departments for either short or long periods of time. This would be on a voluntary basis, of course. It seems to me that most of the technical people are becoming specialists and therefore are, or will be, limited as far as their skills are concerned in the future. This method of rotation would also allow the semiprofessional people more opportunity to become acquainted with other projects and enable them to choose wisely the area in which they would most like to work permanently.

In the same organization, a laboratory manager spoke of the need to complete degree requirements by some professional level research personnel:

> We need to encourage senior employees with productive records to complete their educational requirements, where in many cases these efforts have been abandoned, and the passage of time has rendered such efforts economically unfeasible.

And yet another staff member mentioned postdoctoral work:

> Opportunities for professional development beyond the doctoral level should be provided. The simplest way to do this is to follow the pattern of the better universities and to provide sabbaticals for meritorious service to deserving individuals.

Most studies of technical professional personnel have found that they increasingly experience a sense of becoming "boxed in" (i.e., overspecialized) over time, and hence, they become more concerned with being obsolete with respect to the knowledge and skills required for the performance of their jobs. This progressive concern with obsolescence is expressed in the following "ruminations of a hypothetical interviewee" beginning in NACA, the predecessor of NASA:

> I came to NACA with a master's degree several years ago to work on basic research in aeronautics. I didn't seriously consider industry and its larger salaries because I would be able to do basic research and have more freedom at NACA, would be more secure, and could publish in journals, etc. I started working on a basic research assignment as a GS-7 and stayed with that work for 6 years, also being promoted to GS-9, 11 and 12. Became known as the expert in X around here. After several years I became somewhat tired of it and wanted to switch into Y, but it took a long time to get permission and to make the transition. (Even now, people box me in with their expectations of solving all the X-type problems.) It took a long time for me to bring myself up to snuff in Y and probably I wasn't very useful to them for a while. I took some more course work at night as well as a couple "in-house" courses -- I'm quite uncertain as to how useful these were, but the people here rather expect you to do this.
>
> Recently a project arose in an <u>applied</u> research aspect of Y and I was pressured to try the work for a while. I was somewhat concerned about making the shift because you know it's usually a one-way street from basic to applied research to development work -- once you leave the basic scientific work you never get back.

Most of the men in basic and applied research seem naturally to specialize after they come here. There are at least twice as many specialties among people at my level (GS-12) as among new GS-7's. I've also noticed that among people at GS-14 and 15 there are very few specialties or specialists -- but then most of them are in supervisory positions anyway. Probably you could picture the distribution of grade and specialties (as a diamond). In a way, specializing can be a pit that you dig yourself into -- an increasingly deeper commitment that is hard to get out of -- your niche could become obsolete and dead-end you -- although specializing probably helped me to progress faster when I first began here.

It's a little difficult to see far into my future now -- NASA is evolving rapidly, its goals are yet unclear and the relations between NASA and this Field Center have yet to be worked out. Frankly, it's harder to identify myself with the Field Center now that it's shifted its programs and the goals seem so vague. Also, I was a physicist in college and used to go to most of our society meetings, but that kind of thing seems less important now. I was reclassified as a "space environment technologist" (!) when the new functional classification came out, and the traditional backgrounds never get used much any more. Perhaps functional classification is more realistic, but I vaguely miss my identity as a physicist. Maybe it will become possible to build an image of a "space scientist" but I don't feel that this is yet established.*

In the above summary-type interview comment at NASA, one can observe several attitudes and experiences that are common to technical professional personnel in a variety of government, industrial, and educational organizations. These include:

1. An initial interest in doing science-oriented or discipline-oriented activities (e.g., "basic research"), followed by a gradual involvement, somewhat reluctantly, in activities connected with the applications of science and technology to the

---

* From D. R. Peters, Notes on Career Growth in NASA: Patterning of Interview Responses (Cambridge, Mass.: Massachusetts Institute of Technology, School of Industrial Management, "Working Paper," 1963), pp. 18-9.

specific problems of the employing organization--the latter resulting from the pressures of "organizational socialization" on employees over time.*

2. Associated with (1), a gradual identification of the individual with a particular specialty field, making it more and more difficult for the individual to change specialty fields as time goes by.

3. Associated with both (1) and (2), a gradual shift from a scientific or technical discipline orientation in the individual to a functional job category orientation.

4. As a concomitant of all of these, a growing sense of loss of professional versatility in the individual (e.g., "It took me a long time to bring myself up to snuff in Y," and "It's usually a one-way street from basic to applied research to development work"), and sometimes even a sense of inability to keep up with changing requirements in one's current job (e.g., "Your niche could become obsolete and dead-end you.")

Although increased specialization does not always turn out to be the road traveled by technical professional personnel, there is considerable evidence that many are subject to a loss of professional versatility over time in a wide variety of organizations, whether they specialize or not. In support of this conclusion, an SRI study of two groups of technical professional people (nuclear physicists and organic chemists) at two points in time (six years apart), found that the members of one group (organic chemists) tended to become more specialized, while the members of the other group (nuclear physicists) tended to become more generalized in their work activities.† Yet only 50 percent of the nuclear physicists and 40 percent of the organic chemists indicated that they still felt they are "broadly qualified in their basic disciplines" after six years in the organization studied. About 85 percent of those in both groups said that they are "not completely satisfied" that they have kept up to date with

---

* For a further description of this process in research organizations, see H. M. Vollmer, Adaptations of Scientists and Organizations, Chapter VIII, "Organizational Socialization."

† In the six-year period studied, ten of the organic chemists said they became "more of a specialist," two said they became "more of a generalist," and two said they "remained about the same." Among the nuclear physicists, in contrast, six said they became "more generalized" and one said "more specialized."

the advance of new knowledge and new methods in their technical fields--mostly because of the increased amount of technical literature they have to read. And before-and-after analysis of the amount of time members of the two groups reportedly spend in trying to keep up with the technical literature shows that, on the average, the time spent in technical reading has increased for both groups.* Apparently, scientists in both groups have been reading more, but "enjoying it less" with regard to the extent to which this increased reading has contributed to general professional self-confidence.

Two Kinds of Manpower Obsolescence

Out of the previous discussion, there emerges a recognition of two distinct types of manpower obsolescence among technical professional personnel. These may be described as (1) job assignment obsolescence and (2) professional obsolescence, respectively. Job assignment obsolescence (or "job obsolescence," for short) may be said to occur when an individual does not have the knowledge or skill necessary to perform his present job assignment, either because he once had knowledge or skill that he does not have now or because the knowledge and skill that he has retained are not sufficient for changed job requirements. In contrast, professional obsolescence may be said to occur when an individual does not have the knowledge or skill necessary to perform in the normal range of different job assignments that can characteristically be performed by members of the relevant professional group. Again, this may result either from individual loss of professional knowledge or skill, changes in professional requirements, or perhaps both. Thus, in sum, job obsolescence refers to

---

* In 1961, the average amount of total time per week at work and home reported spent in reading technical literature was 7.3 hours among the nuclear physicists; this had increased to 9.5 hours per week in 1967. In 1961, the organic chemists spent, on the average, 7.2 hours per week in reading technical literature; this had increased to 12.3 hours in 1967. In comparison, one survey has shown that electronics engineers spend about 3 hours per week, on the average, in reading technical literature while at work; see S. A. McMillion and B. F. Osbahr, "How do Engineers Keep Up-To-Date," Electronic Industries, Vol. 22 (May 1963), p. 80. One authority has concluded that engineers need to spend at least 8 hours per week (20 percent of their time) in retraining activities; J. K. Wolfe, "Keeping Up to Date -- In Career Training in the U.S.A.," Electronics and Power, Vol. 11 (August, 1965), p. 260.

a lack of specific job-relevant capabilities, while professional obsolescence refers to a lack of professional versatility.*

Once this distinction is made, one can raise the further question: How extensive is each type of manpower obsolescence? More specifically, about how many scientists and engineers are significantly affected by either type of manpower obsolescence? How do these types vary among technical professional personnel in different kinds of organizational environments? Among personnel in different age categories? Among personnel at different educational levels? Is there any way of beginning to estimate the costs of these kinds of manpower obsolescence to employing organizations (as well as the obvious "human costs" to the individuals concerned)? Finally, what are the implications of manpower obsolescence for organizational design? Can we begin to speculate on how organizations might be designed in the future so that they reduce, if not eliminate, the degree to which they induce job obsolescence and/or professional obsolescence? In sum, can we envision organizations that operate efficiently and yet that produce (or regenerate) talent to an extent that at least offsets the degree to which they consume talent?

To begin to answer this array of questions, we must consider first how we might be able to measure the extent of each kind of manpower obsolescence. We need appropriate indicators of both job obsolescence and professional obsolescence.

Preliminary investigation of this matter has led to the conclusion that two general kinds of indicators of both kinds of obsolescence are useful. One set of indicators may be identified as direct-report indicators; the other may be designated as indirect or inferential indicators.

---

* This twofold categorization of types of manpower obsolescence is a modification of Ferdinand's threefold typology; see T. N. Ferdinand, "On the Obsolescence of Scientists and Engineers," American Scientist, vol. 54 (1966), pp. 46-56. Ferdinand distinguishes "a real obsolescence" (specialty obsolescence) as a third type. However, it appears likely that there is an inverse correlation between the extent of specialty obsolescence and professional obsolescence--e.g., as individuals tend to become overspecialized over time, by definition, they also become obsolete in terms of professional versatility. Therefore, it would appear that a concept of specialty obsolescence distinct from professional obsolescence is not greatly useful to the analysis of this general problem area; the two types identified in the text above appear to be sufficient.

A direct indicator of the experience of job obsolescence could be a negative response to a question like: "Do you feel that you are keeping up to date on new scientific or technical developments in your field to the extent required by your present job?" A direct indicator of professional obsolescence could be a negative response to a question like: "Do you feel that you are currently keeping up to date on new scientific or technical developments to an extent comparable to that of effective members of your scientific profession?"

On the other hand, an indirect indicator of job obsolescence could be some kind of performance disability, such as a failure to produce any scientific publications over a specified time period among research scientists,* or an inability to produce satisfactory engineering designs according to schedule by design engineers, etc. Perhaps the best indicators of professional obsolescence assess the inability of individuals to move from one kind of job position to another within the normal range of jobs held by members of the same professional grouping--i.e., measures of professional labor immobility.

The two following sections of this chapter will discuss the extent of job obsolescence and professional obsolescence in the United States at present, using some of these kinds of indicators.

The Extent of Job Assignment Obsolescence

Conservative estimates of the overall extent of job obsolescence (loss of knowledge or skill necessary to perform a present job assignment) indicate that job obsolescence may be a serious problem among about one in fifteen physical scientists and perhaps more than one in five engineers in the United States at present.

The estimated extent of job obsolescence among scientists can be based on the following direct and indirect indicators. As an example of a direct indicator, in a national survey of scientists (physicists, chemists, biologists, and mathematicians) conducted by SRI, 8 percent of the total number of 3,691 scientists surveyed admitted that they have

---

* For a general discussion of different kinds of publication indexes as measures of scientific productivity, see H. M. Vollmer, "Evaluating Two Aspects of Quality in Research Program Effectiveness," in M. Yovits, et al.,eds., Research Program Effectiveness (New York: Gordon and Breech, 1966).

not experienced "opportunity to keep up to date on new scientific developments in my field." (The proportions giving this response varied from 9 percent among mathematicians to 8, 7, and 6 percent among chemists, biologists, and physicists, respectively. Also, the proportions increased only very slightly with age--6, 7, and 8 percent for all scientists surveyed in their twenties, thirties, and forties, respectively, and then declined again to 7 percent for those in their fifties and over.)*

As an example of a possible indirect indicator of job obsolescence from the same national survey, it was found that about 9 percent of all scientists surveyed have produced no scientific or technical publications within the past five years. Moreover, a cross-tabulation of data from this survey shows a high degree of association between producing no publications in a five-year period and the reported experience of not keeping up to date in one's scientific field. The analysis reveals that only 2 percent of "high producing scientists" (in terms of their output of publications) report that they have not had opportunity to keep up to date in their scientific fields, whereas 12 percent of "low producing scientists" say that they have not had opportunity to keep up to date. In other words, the proportion that allegedly has not been able to keep up to date is six times higher among low producers than among high producers.

Thus, the experience of obsolescence in terms of knowledge or skill is statistically associated with lower scientific productivity, although the direction of causality can not be determined by these data. It could be that inability to keep up to date in scientific knowledge and skills is, in part at least, a cause of lower scientific productivity. Or it could be that inactivity with regard to the production of publishable scientific findings also partly causes one's scientific knowledge and skills to atrophy. Or, on the other hand, both could result from a scientist's being employed in an organizational environment that does not encourage keeping current in scientific knowledge and in scientific outputs. In any case, however, there is evidence here that direct indicators (self-reports of inability to keep up to date) and indirect

---

* See N. M. Vollmer, Work Activities and Attitudes of Scientists and Research Managers: Data from a National Survey (Menlo Park, Calif.: Stanford Research Institute, "R&D Studies Series," 1964) p. 48.

indicators (failure to produce publications in the scientific literature) tend to corroborate each other as signs of deficiency in job performance.*

The findings discussed previously are supported further by findings from other surveys of scientists. A nationwide survey of chemists found that from 7 and 9 percent of Ph.D. chemists in universities and in industry, respectively, reported that it is "not characteristic of their organizations to make it easy to keep up with the field by providing library facilities, seminars, and the like."† In answer to another question in the same survey, 4 and 6 percent of the professional chemists in universities and in industry indicated that it is not characteristic in their organizations that their co-workers are "highly competent."‡ (This latter statement might be taken as another kind of indirect indicator of the general extent of job obsolescence among the e particular kinds of scientists in universities and industry).

In another survey of scientists in industry, a somewhat larger proportion of scientists--14 percent--agreed with a statement that "there is little incentive for engineers and scientists to keep up on new developments in their field."§ Three percent "definitely agreed" with this statement. Again a somewhat comparable proportion of scientists--8 percent--rated their scientific colleagues as "only fair" to "not too competent" in the performance of their technical job duties.**

---

* Contrary to the conclusions of earlier studies, more recent data have shown no continuous decline in scientific productivity with advancing age; actually, there are two peaks in scientific productivity over the life span of scientists; see D. C. Pelz and F. M. Andrews, Scientists in Organizations: Productive Climates for Research and Development (New York: Wiley, 1966), Chapters 10 and 11. Data on scientists in SRI studies show the same two-peaked curve of productivity.

† See A. L. Strauss and L. Rainwater, The Professional Scientist: A Study of American Chemists (Chicago: Aldine, 1962), p. 115.

‡ Ibid., p. 112.

§ See Opinion Research Corporation, The Conflict Between the Scientific Mind and the Management Mind (Princeton: Opinion Research Corp., 1958), p. A-44.

** Ibid., p. A-14. Further evidence that it may be normal to expect somewhere in the neighborhood of 8 percent of scientific work (or of scientific employees) to be technically incompetent is given by data from a study of "bench scientists," "supervisors," and "project monitors" in eight Army research laboratories. The study found that 6 percent of the bench scientists, 12 percent of the supervisors, and 6 percent of

For scientists without Ph.D. degrees, there are indications that the extent of job obsolescence tends to be somewhat larger than is generally true for Ph.D. scientists. Thus, in the national survey of scientists conducted by SRI, it was found that 6, 8, and 9 percent of doctoral-level physicists, chemists, and mathematicians, respectively, reported that they currently do not have opportunity to keep up to date on scientific developments. The comparable proportions of scientists in the same three disciplines who do not hold Ph.D. degrees are 8, 11, and 11 percent, respectively--or in other words, 2 or 3 percent higher than the Ph.D.s in their same fields.*

Other surveys have found larger differences. For example, the Strauss-Rainwater study of chemists found that, while 9 percent of the doctoral-level chemists in industry indicated that their organizations do not make it easy to keep up with their fields, the comparable proportions were 18 percent for non-Ph.D. chemists in industry, 26 percent for "bench chemists" (technical assistants), and 23 percent for chemical engineers.† The Opinion Research Corporation study found that, among scientists and engineers combined, 14 percent of doctors, 16 percent of masters, and 24 percent of bachelors agreed that "there is little incentive for engineers and scientists to keep up on new developments in their field.‡

There are a variety of indicators that the proportions of job obsolescence are considerably higher among engineers, in general, than among physical scientists. Thus, for example, in the Opinion Research Corporation study, the high figure of 30 percent of the ergineers agreed that "there is little incentive for engineers and scientists to keep up on new developments in their field." In a survey of professionally oriented engineers (members of the National Society of Professional Engineers), 14 percent indicated that "a chance to keep up with new developments in your field" was among the things most lacking in their present jobs.§

---

the monitors reported dissatisfaction because their "subordinates turned out poor work"; Dale W. Dysinger, Motivational Factors Affecting Civilian Army Research and Development Personnel (Pittsburgh, Pa.: American Institutes for Research, 1965) p. 63.

* Vollmer, Work Activities and Attitudes of Scientists and Research Managers, p. 144.

† Strauss and Rainwater, op. cit., p. 115.

‡ Opinion Research Corporation. op. cit., p. A-44.

§ See The Professional Engineers Conference Board for Industry, Career Satisfactions of Professional Engineers in Industry (Washington, D.C.: Professional Engineers Conference Board for Industry, 1960), p. 59.

In the same survey, 18 percent of the engineers also indicated that opportunity for further training was also lacking in their present jobs. In an SRI study of research scientists and engineering personnel in an aerospace company, 22 percent of the engineers (compared with 10 percent of the scientists) said that they currently do not feel that they have opportunity to keep up to date on new technical developments. In a similar SRI study of research scientists and nuclear engineers in the atomic equipment division of a large industrial corporation, 19 percent of the engineers (compared with 4 percent of the scientists) gave this same response.

There is more indirect evidence from other studies that points to the same conclusion that at least one in five engineers (on the average in a variety of situations), if not more, is markedly affected by some kind of job obsolescence. In a national survey of engineering graduates, 42 percent of 3,246 respondents agreed with the statement: "My colleagues seem out of date and need more study."* Another survey of 1,000 engineers and engineering managers has reported the very large proportion of 95 percent of the engineers (and 86 percent of the engineering managers) indicating that technical obsolescence is a "real problem."†

Another indirect indicator of the extent of job obsolescence is assessment of the proportion of engineers who show a strong desire for additional training in technical areas related to their job responsibilities. One survey of 2,100 engineers in 176 companies in 20 industrial categories found that 40 percent or more of the respondents wanted additional training in a variety of technical areas. The largest proportions (over 50 percent of the respondents) indicated a specific desire for additional training in such topics as engineering economics, engineering analysis, computer programming, engineering materials, information data processing, automation, probability and statistics, and "review of college mathematics."‡ Another study of engineers in aerospace companies in the Los Angeles and Seattle areas found that over 30 percent of the respondents desired

---

* See W. K. Lebold, R. Perruci, and W. Howland, "The Engineer in Industry and Government," Journal of Engineering Education, Vol. 56 (1966), p. 255.

† See Princeton Creative Research, Inc., "Engineers Talk about Obsolescence," Machine Design (June 18, 1964), pp. 148-51, and "Who Pays for Technical Retooling," Machine Design (July 2, 1964), pp. 92-5, and "Attitudes on Education," Machine Design (July 16, 1964), pp. 124-27.

‡ See R. W. Christian, "Personal Obsolescence," Factory, Vol. 122 (October 1964), p. 111.

additional training in probability and statistics and in computer programming and data processing.* In a survey of chemical engineers by their professional association, a definite interest in advanced training in a variety of technical subjects was expressed by over 25 percent of the society membership.† In the General Electric Company, 36 percent of the technical professional personnel are involved in retraining programs.‡

Finally, a study of layoffs among engineers and scientists in the aerospace and electronics industries of the San Francisco Bay Area in the period of 1963 to 1965 found that, after a two-year time period, 6 percent of these personnel were still unemployed, and another 15 percent had found it necessary to take jobs in "non-engineering/scientific work."§ This would seem to provide further evidence of the inability of about one-fifth of these technical professional personnel (most of whom are engineers, rather than scientists) to qualify for technical positions in their respective disciplines.

If, as the data discussed previously suggest, at least one in fifteen scientists and at least one in five engineers experience job obsolescence as a major problem, we can conclude that out of an estimate of 500,000 scientists in the United States at present, over 33,000 may be experiencing job obsolescence as a marked problem. Out of an estimated 1,200,000 engineers in the United States, 240,000 may also be experiencing job obsolescence as a marked problem.** Thus there is reason to believe that job

---

* See W. D. McIlvaine, The Professional Technical Employee: What Factors Affect His Continued Growth (Los Angeles: University of California at Los Angeles, Department of Engineering, 1966), pp. 16-7.

† See J. C. Smith, "Credit-free College Courses: an Impending Explosion" Chemical Engineering, Vol. 74 (April 24, 1967), p. 140.

‡ See Wolfe, op. cit., p. 261.

§ See R. P. Loomba, A Study of the Re-employment and Unemployment Experiences of Scientists and Engineers Laid Off from 62 Aerospace and Electronics Firms in the San Francisco Bay Area during 1963-65 (San Jose, Calif.: San Jose State College, Center for Interdisciplinary Studies, 1967), pp. 49, 77. Those in "non-engineering/scientific" work were found to be engaging in a variety of occupations, such as insurance, real estate, and used car sales.

** The estimates of the total number of scientists and engineers in the United States at present are based on interpolations of NSF data; see National Science Foundation, Profiles of Manpower in Science and Technology (Washington, D.C.: NSF 63-23, 1963), p. 7; and National Science Foundation, Scientists, Engineers, and Technicians in the 1960's (Washington, D.C.: NSF 63-34, 1963), pp. 34-5.

obsolescence represents one serious source of loss of talent on a national level, especially for engineers. Moreover, if efficient ways to prevent this loss were developed through retraining programs and other appropriate methods for the regeneration of talent, it can be seen that the projected national shortage of engineering talent in the decade of the 1960s amounting to somewhere in the neighborhood of 265,000 engineers, might be markedly alleviated.* This implies, however, that organizations that employ engineers (and scientists also) must become willing to devote more effort to overcoming job obsolescence among their scientific and technical employees. In turn, implications can be drawn for manpower utilization policy at the national level, as well as for the design of goals, structures, and policies at the corporate level.

To achieve the latter, the managements of corporations (including government, educational, nonprofit, and industrial institutions) must be convinced that corporate contributions to programs oriented toward the regeneration of technical talent are economically efficient--i.e., cost less than the costs of consuming talent without trying to regenerate it. This certainly requires special tailormade considerations in each employing organization, according to the nature and scope of the job obsolescence problem among its scientific and technical personnel. It is sufficient to point out here the importance of taking such considerations into account within the overall topic of organizational design or redesign. If the situation in a particular corporation is similar to what may exist for the nation as a whole, the corporation management can expect that more than one out of fifteen of the scientists on its staff and more than one out of five of its engineers experience job obsolescence as a serious problem. What is the loss to the employer in salary and other compensation to this proportion of its employees who are no longer technically equipped to perform their jobs adequately? What is the overall loss in corporate productivity of present products? What is the loss in terms of new product markets that a corporation has been unable to enter?

Such questions are difficult, if not impossible, for any corporate management to answer. But perhaps the key question for corporate goals and policy implications is: What are the costs to an employer of assisting in the regeneration of present talent compared with the alternative costs of employee turnover--the costs of dismissing technically ineffective employees and recruiting and training others to replace them?

---

* This projected shortage, resulting from an expected discrepancy between the supply and demand for engineers in the 1960s, is reported in Scientists, Engineers, and Technicians in the 1960's, p. 29.

Even this fairly straightforward cost-effectiveness problem needs to be related to two other broader cost considerations: (1) the cost to the morale and productivity of currently effective employees where there is a corporate policy of consuming talent among their colleagues without assisting in the task of regenerating it and (2) the cost to the nation as a whole in releasing older scientists and engineers into a labor market in which their employability has decreased because their technical talent is not commensurate with present-day technological advances.

The Extent of Professional Obsolescence

The latter consideration serves as a transition into a discussion of professional obsolescence. It will be recalled that professional obsolescence may be said to occur when an individual has lost the knowledge or skill necessary to perform in the normal range of different job assignments that can characteristically be performed by members of the relevant professional group. Examination of survey data indicate that it is not as easy to identify professional obsolescence by direct indicators, as has been done in the case of job obsolescence. However, the ease with which individuals can move from one technical professional job to a similar job in the same professional area, but in another employing organization, appears to be a useful--albeit more indirect--measure of professional obsolescence. In contrast to indicators of job obsolescence, indicators of professional obsolescence show a marked increase with the increasing age of individuals.

Considering only those scientists with the highest amount of professional training (those with Ph.D. degrees), data from the national survey of scientists conducted by SRI indicate that the proportion of scientists who would reportedly find it "not very easy to get a similar position in another organization" is 8 percent for scientists in their twenties, increasing to 11, 20, and 24 percent for those in the thirties, forties, and fifties-and-over age categories, respectively. This increasing inability to market one's skills in a variety of professional positions with advancing age is apparently associated with increasing specialization. An indicator of this is provided by data from the same national survey, which show that in their twenties, 65 percent of the scientists stated that they wish "to remain in their same line of work" in the future (in contrast to "going into another line of work" or "going into management"), while the proportions who desire to stay in their "same line of work" increases to 69, 76, and 83 percent among scientists in their thirties, forties, and fifties-and-over, respectively. Simultaneous with this increase in specialization is a decrease in professional orientation among scientists, at least from their thirties on

to the end of their careers. Those who state that they "identify themselves primarily with their scientific profession" (rather than their employing organization) decline from 81 percent in the thirties to 79 percent in the forties and 70 percent in the fifties-and-over category. One can infer from these data that overspecialization and a concomitant lack of professional versatility appears to be a marked problem for about 10 to 20 percent of these scientists in their younger years, increasing to about 25 to 30 percent in the older age groups.

Other surveys have asked more direct questions on overspecialization. The Strauss-Rainwater study found that 26 percent of Ph.D. chemists in industry report that "specialization is a problem" and that this is even more common among non-doctorates (35 percent).* As one researcher put it in answer to the question: "What dangers does chemistry as a field face today":

> I would say overspecialization. There's more and more to know and more and more to work on, and you can't know everything. You tend to know more and more about less and less.

Similarly, the Opinion Research Corporation study found that 18 percent of the scientists surveyed and an even higher proportion of engineers (25 percent) "definitely agreed" with the statement that: "Company practice often forces engineers and scientists to overspecialize."† Again, this latter study found that overspecialization was more frequently reported among non-Ph.D. scientists and engineers (21 to 22 percent) than among those with Ph.D. degrees (17 percent).†

The Strauss-Rainwater and Opinion Research Corporation surveys do not present a breakdown of data on overspecialization and consequent lack of professional mobility by age categories, but data from additional SRI surveys show that the proportion of engineers who plan to transfer to a job in their engineering field in another company decreases steadily from 38 percent for those in their twenties, to 22, 14, and 4 percent for those in their thirties, forties, and fifties, respectively. In the same age periods, those who say that they are primarily oriented toward the engineering profession, rather than their employing organization, declines steadily with age from 54, through 45 and 36, to 31 percent for those of age fifty or over.

---

* Strauss and Rainwater, op. cit., p. 210.

† Opinion Research Corporation op. cit., p. A-45.

There is other evidence that older scientists and engineers actually have more difficulty in obtaining other jobs in their professional fields as they advance in age. Thus, for example, the Loomba study of unemployment and re-employment experiences of engineers and scientists who were laid off found that among those of 35 years of age or less, 26 percent were laid off for 18 weeks or more before they were able to find another job in their professional fields. Twenty-eight percent of those from ages 36 through 45, and 43 percent of those of ages 46 or older, were unemployed for at least 18 weeks. Conversely, 29, 17, and 19 percent of the younger to the older age groups were able to find new employment within four weeks of the time they were laid off.*

Much of the professional obsolescence of engineers and scientists associated with age results from the fact that the specialty fields in which the engineers or scientists have been trained and to which they have become committed, have "gone out of date." David Allison pointed out in 1964, for example, that about one-half of the 700,000 engineers who held bachelor's degrees at that time had received these degrees before 1953, which was about the time that the leading engineering schools began to put more emphasis on training in scientific fields and in mathematics and less on "how-to-do-it courses." Allison writes that this older half of the engineering profession:

> . . . are not merely in need of brush-up courses, courses that rub off the rust. Rather, they lack the fundamentals of modern technology--from modern math to computer utilization--unless they have kept up in the intervening years, whether by attending classes regularly, at nearby schools or at work, or by diligent study of on-rushing technical literature, most of which is incomprehensible, having been written to be published rather than read and understood.

Allison amplifies these comments by showing that the "hot" space engineering specialty fields in the 1950s were servomechanisms, operations research, microwaves, nuclear engineering, rocket propulsion, polymers, and solid-state devices. In the 1960s, attention has focused on such fields as automation, computer technology and computer-aided design, microelectronics, superconductivity, advanced communications theory, plasma physics, and extraterrestrial engineering. By the 1970s, he predicts that engineering could include substantial aspects of behavioral science,

---

* Loomba, op. cit., p. 52.

self-organizing machines, electro-optics, plasma engineering, exogeology and exobiology, psychopharmacology, and biological engineering. He notes that the fields of greatest excitement in engineering today are not simply outgrowths of earlier "hot" technologies, but instead have grown out of developments in basic scientific fields, and that the up-to-date professional engineer must master these kinds of relevant scientific fundamentals.*

Even in the basic scientific or theoretical disciplines, however, there are areas in which professional obsolescence can result over time from earlier commitments to specialty fields that are now out of date. Warren Hagstrom has reproduced the following passage from an interview with a mathematician, which Hagstrom says is typical among mathematicians in the university contexts that he studied:

> This happens particularly among older mathematicians who started research along a particular line. Let me give you an example: At the turn of the century, a hot area in mathematics was the so-called theory of geometrical invariance. At the time, the notion of invariance was recognized as unifying a great many geometrical ideas. So there was an enormous study of invariance at the time. It was a fairly technical and fairly narrow area, and a lot of Ph.D.'s were being turned out at that time in the theory of invariance. Well, this went on for a time, and pretty soon they exhausted almost everything that could be said; the field wasn't closed, there were still a great many things to be done, but it was generally realized that what you were going to say would be more of the same kind of thing. It really wasn't going to bring entirely new ideas into the field. I've known a good many mathematicians, now all in their sixties, who were trained in this field, did their research in the area for many years, and didn't learn any of the related mathematics at the time. When the popularity of invariance theory went down they were simply left stranded. For example, they had difficulty getting papers published, because editors were just not interested in the material. So that they were perfectly aware that the field had passed them by, and they eventually gave up doing research. They felt they

---

* See D. Allison, "Engineer Renewal" International Science and Technology, No. 30 (June 1964), p. 49.

were too old to branch out into new fields and it was as plain as could be that it was impossible for them to receive recognition for research in what they had done. Obviously they were quite discouraged and frustrated.*

Whereas we estimated previously that job obsolescence appears to affect at least one in fifteen scientists and one in five engineers, we can see from the evidence presented in this section that professional obsolescence is probably much higher among scientists and engineers, especially among those in the older age categories. Overall, without regard to age differences, professional obsolescence appears to be a serious problem for about one-fourth of the physical scientists and perhaps about one-half of the engineers in the United States.

Again, one can raise questions on what degree of responsibility employing organizations should assume to help overcome this tremendous consumption of professional talent, compared with the degree of responsibility that individuals, professional associations, and the federal government should assume. Since professional obsolescence, by definition, involves job transferability rather than current job performance, one might be inclined to argue that the federal government (in the interests of national manpower utilization) and professional associations (in the interests of their membership) should assume more responsibilities in this regard than employing organizations. Nevertheless, to argue that employing organizations should not, at least, share in the sponsorship of various programs to help alleviate professional obsolescence can be an extremely narrow and shortsighted view of managerial responsibilities. It would ignore the degree to which employing organizations are increasingly dependent on a highly fluid supply of technical professional manpower (i.e., scientists and engineers who move from one employing organization to another several times in their careers). It would ignore the degree to which mergers and product diversification are forcing many large corporations to consider the internal job transferability of technical professional personnel. And finally, it would ignore increasing pressures for corporations, both private and public, to be organized and managed in ways that contribute to public interest and public welfare, as well as to private profit.

---

* See W. O. Hagstrom, The Scientific Community (New York: Basic Books, 1965), p. 233.

Chapter V

ORGANIZATIONS AS WASTERS OF TALENT

The last chapter described how organizations tend to consume talent among sizable proportions of their employees by employing them in job assignments for which they are no longer qualified or in job assignments that reduce their professional versatility through overspecialization. In a sense, then, these are variations in the overutilization of talent. In contrast, this chapter discusses the underutilization of talent. Many organizations not only use up talent by permitting manpower obsolescence, but also fail to employ fully certain kinds of actual or potential talent when it is available and when it would be to the organization's advantage to employ this talent more completely. When intellectual talents are not fully employed, they can be expected to atrophy, similar to the condition among muscles of the body when exercise is lacking--or in terms of learning theory, when reinforcement is not present. Thus what can be referred to as "the waste of talent" in the short run, results in the consumption of talent in the long run. Underutilization and overutilization eventually turn out to be two sides of the same coin.

The Underutilization of Technical Talent

Many observers of employer practices have noted various forms of the underutilization of talent in different organizations. For example, in answer to the question, "Is there a waste of talent?" the Killian Committee wrote: "The Committee recognizes the existence of some waste of scientific and engineering talents inherent in practices such as 'goldplating,' 'brochuremanship,' and 'stockpiling' of manpower." (The latter refers to a company keeping more scientists and engineers on its payroll than the fulfillment of its current government contracts requires, to make it easier to obtain and man new projects.) The Killian Committee recognized that special case studies of the Titan II and the Naval Tactical Data System programs had found no positive evidence of stockpiling, but nevertheless cautioned that "abuses" in this regard could occur and should be avoided.*

---

* See Committee on Utilization of Scientific and Engineering Manpower, op. cit., pp. 27-8.

Moreover, Arthur Ross (currently Commissioner, Bureau of Labor Statistics, U.S. Dept. of Labor) wrote for the Committee the following strongly worded comments:

> Inability to exercise professional skills is one of the evident and most chronic complaints of employed professionals. It is a persistent theme in surveys of scientific and engineering work. I might add that I have seen a great deal of it myself, in the course of arbitrating industrial disputes in private industry over the past 15 years.
>
> Manpower "loading" or "hoarding" in order to be in a position to accept new contracts . . . is a frequently noted phenomenon closely related to the competitive conditions discussed above. If expiring projects and new projects are nicely dovetailed, waste of manpower may be avoided. Otherwise the excess personnel must be assigned to some project or other. I am not suggesting that it would be desirable or practical to demobilize or remobilize research organizations in response to irregularities of manpower demand. The point is that procurement authorities should regularize demand to a greater extent so that excess capacity can be minimized.*

Ross goes on to note declining ratios of technician support for engineers and scientists as indicative of the underutilization of professional talent:

> In the aerospace industry there were 42 technicians for every 100 scientists and engineers in 1955, but only 37 in 1961. After so much talk about manpower utilization, greater subprofessional support would be expected, but actually it declined.†

Clues on the extent of the underutilization of talent are provided in surveys, such as the Strauss-Rainwater survey of chemists, which found that 24 percent of the chemists in universities, 22 percent of those with

---

* Ibid., p. 88.

† Ibid., in turn cited from A. Shapero and H. M. Vollmer, "Technical Profile of the Aerospace Industry," Appendix H, in G. Hayes, The Industry-Government Aerospace Rolationsnip (Menlo Park, Calif.: Stanford Research Institute, 1963), p. 248.

Ph.D.s in industry, and 29 percent of the non-Ph.D.s in industry said that the statement "some of my duties are really below the level of my training and skill" was "very characteristic" of their jobs.* The Opinion Research Corporation Survey found 34 percent of the scientists and 43 percent of the engineers "definitely agreeing" that "the so-called shortage of scientists and engineers is caused largely by poor utilization of available talent by management."† Loomba in his survey of engineers (mostly) and scientists laid off in 1963-65 found the very large proportion of 60 percent of the respondents saying that their scientific and technical training was not "utilized to the fullest extent" on their jobs before they were laid off. Closer examination of the reasons given for this response reveals that about 13 percent of those in Loomba's survey were actually indicating their general dissatisfaction with their past management (understandable in a group of people recently laid off), another 17 percent were apparently overutilized in their past jobs ("engaged in work different from what was trained for" or "job required skills in too narrow a specialization"), 4 percent gave a variety of "other" responses, and 26 percent gave responses indicating underutilization--"company needed a person with less education and training," "unchallenging and unstimulating work," "too much administrative work," and "company did not need a technically trained person."‡ A Brookings survey found a total of 11 percent of natural scientists and 18 percent of engineers in industrial employment indicating that their "work does not fit capabilities or training" or that there is "too much routine in the work; monotonous, not enough change, variety," etc. Almost identical percentages--11 and 17 percent, respectively--of scientists and engineers employed by the federal government gave the same responses.§

From data such as those cited above, we could infer conservatively that at least one-tenth of the scientists and one-fifth of the engineers in a variety of organizations experience underutilization of their talents

---

* See Strauss and Rainwater, op. cit., p. 112.

† See Opinion Research Corporation, op. cit., p. A-41.

‡ See Loomba, op. cit., p. 43.

§ See F. P. Kilpatrick, M. C. Cummings, Jr., and M. K. Jennings, Source Book of a Study of Occupational Values and the Image of the Federal Service (Washington, D.C.: The Brookings Institution, 1964), p. 207.

as a serious problem. A major factor in this underutilization appears to be inadequate technical support; scientists and engineers often have to perform functions that could be performed by less highly trained subprofessional personnel. Shortages in technical support are especially marked among scientists and engineers in federal government employment and in the aerospace, petrochemical, and chemical-pharmaceutical industries. Data from the national survey of scientists, conducted by SRI, indicate discrepancies of 23 percent among scientists in federal government laboratories, 19 percent in aerospace companies, 26 percent in food and drugs (chemical-pharmaceutical) companies, and 13 percent in petrochemical companies between the proportion who say that "adequate technical assistance" is "quite important" in their work, and the proportion who say that they have experienced "adequate technical assistance" in their work. This compares with a total industrial average of 12 percent and with 8 and 9 percent in universities and nonprofit organizations, respectively, in measures of discrepancy between the desire for, and the experience of, technical assistance.* In the same survey, in answer to the question, "Which is presently the most serious or pressing kind of problem you face in your research position?" 23 percent of the scientists in the federal government and 5, 14, and 17 percent of those in aerospace, petrochemical, and food and drug companies indicated "inadequate number of appropriately trained technicians." (A larger proportion of those in aerospace companies--34 percent--indicated "limited or uncertain funding for research" as their most serious problem.)†

Data on the actual ratios of technicians to scientists and engineers support the above attitude survey findings that those in the federal government and in aerospace, petrochemical, and chemical-pharmaceutical companies suffer most from a lack of technical support. The national average is 66 to 67 technicians for every 100 scientists and engineers, but the aerospace, petroleum, and chemicals-allied products industries had only 46, 42, and 44, respectively, in 1960.‡ The overall ratio of technicians to 100 scientists and engineers in the federal government is 62, but further analysis indicates that this is most reflective of technician support for engineers (about 80), rather than for physical scientists (about 37)

---

* See Vollmer, Work Activities of Scientists and Research Managers: Data from a National Survey, p. 95.

† Ibid, p. 90.

‡ See National Science Foundation, Scientists, Engineers, and Technicians in the 1960's, p. 36.

in the federal government service.* Furthermore, projections indicate that these support ratios are not expected to increase very much up to 1970.†

The manpower-space control system existing in many federal government research laboratories is a major contributor to the underutilization of physical scientists. Characteristically, a certain number of "manpower spaces" are allocated to each laboratory director. He can fill these spaces with fully trained scientists or with technicians, clerical personnel, etc. The natural tendency--if only for organizational prestige purposes--is to try to fill most of these spaces with full-fledged scientists, Ph.D.-level people if possible. But, in consequence, many government scientists end up having to do their own technical work, and sometimes even clerical and other "paper-shuffling" duties, resulting in strong feelings of underutilization.‡

In the comment by Arthur Ross, quoted earlier, it was mentioned that technician support ratios have apparently decreased in recent years in the aerospace industry. This decrease could be somewhat deceptive, however, in that other data show that from 28 to 38 percent of the "professional-level workforce" in defense-related industrial establishments (mostly aerospace) do not have college degrees.§ In some major companies, as high as 12 percent have had no college training whatever.** This suggests that many individuals who might be classified as "technicians" may be

---

* See U.S. Civil Service Commission, Federal Workforce Outlook (Washington, D.C.: USCSC, 1965), pp. 7-8.

† See National Science Foundation, Scientists, Engineers, and Technicians in the 1960's, p. 36.

‡ These observations are primarily drawn from two years of study of Air Force research laboratories, partly reported in H. M. Vollmer, Applications of the Behavioral Sciences to Research Management: an Initial Study in the Office of Aerospace Research (Menlo Park, Calif.: Stanford Research Institute, "R&D Studies Series," 1964).

§ See A. Shapero, R. P. Howell, and J. R. Tombaugh, The Structure and Dynamics of the Defense R&D Industry: the Los Angeles and Boston Complexes (Menlo Park, Calif.: Stanford Research Institute, "R&D Studies Series," 1965), p. 19.

** Shapero and Vollmer, op. cit., p. 260.

classified as "professionals" in the defense-related sectors of the aerospace industry, perhaps in part as an aspect of the "brochuremanship" and "stockpiling" practices referred to in the Killian Committee report. In any case, it would appear that upgraded technicians, who may be (on paper at least) overutilized, do not completely offset the underutilization of many fully-trained scientists and engineers in aerospace companies.*

Why markedly low ratios of technician support are found in the petrochemical and chemical-pharmaceutical industries is less easy to understand. However, in part, the low ratio may reflect the fact that many non-Ph.D. level chemists and "bench chemists" are employed in industries to support the work of Ph.D. chemists. Perhaps as a consequence of being assigned to technical support functions, rather than to positions with more professional independence, these non-Ph.D. chemists are even more likely to experience feelings of underutilization than are the Ph.D. chemists. The Strauss-Rainwater survey found that 33 percent of the "bench chemists," 29 percent of the non-Ph.D. chemists in industry, and 22 percent of the Ph.D.s said it was "very characteristic" that "some of my duties are really below the level of my training and skill."†

As a whole, the electronics industry is an example in marked contrast with those mentioned above regarding the extent to which companies provide technician support for their scientists and engineers. There are about 95 technicians for every 100 scientists and engineers in the electronic components and accessories industry.‡ When asked in the national survey of scientists about their "most serious problem," only 8 percent of the scientists in electronics companies indicated an inadequate number of appropriately trained technicians; the largest proportion of those in any employment category (30 percent) indicated "no problem worth mentioning."§ The discrepancy between the proportion of scientists in electronics

---

* Further evidence supporting this conclusion is provided by data from the national survey of scientists, showing that the rate of general job dissatisfaction is markedly higher (15 percent "dissatisfied" or "very dissatisfied") among scientists in the aerospace industry than in any other context of employment; Vollmer, Work Activities and Attitudes of Scientists and Research Managers: Data from a National Survey, p. 84.

† See Strauss and Rainwater, op. cit., p. 112.

‡ See National Science Foundation, Scientific and Technical Personnel in Industry, 1961 (Washington, D. C.: NSF 63-32, 1963), p. 21.

§ See Vollmer, Work Activities and Attitudes of Scientists and Research Managers: Data from a National Survey, p. 90.

companies who say that adequate technical assistance is quite important and those who say that they have adequate technical assistance is only 2 percent.* And in response to a question on general job satisfaction, only 3 percent said they are "dissatisfied" or "very dissatisfied." An unusually high proportion of scientists in electronics companies (80 percent) report that "management has given my scientific work the recognition it deserves," thus lending further support to the conclusion that talent tends to be employed in especially fruitful ways in this industry.†

The Loss of Technical Talent

Although organizations may not always be able to employ technical talent fully at any given point in time, one might expect organizations to learn to use talent more effectively as time goes by and also to find ways both to increase needed talent in present employees and to eliminate those whose talent cannot be increased through the turnover of personnel. Chapter IV has documented the extent to which organizations have failed to increase talent among present employees--i.e., the extent to which they allow job assignment and professional obsolescence to occur. Here we examine the extent to which many organizations actually appear to lose their more talented employees.

There are few good qualitative studies of turnover among scientific and engineering personnel. Those that exist suggest that scientists and engineers who leave companies are likely to be as talented, at least in terms of broad professional versatility, as those who stay--if not more talented. Thus, a careful and comprehensive study of 640 engineers who left the General Electric Company in comparison with 720 engineers who remained in the company showed that those who left were more likely to be "aggressive," "self-confident," and "broad-gauged" in their interests and abilities, while those who stayed were more likely to have interests and abilities related to particular engineering specialties within the company. The conclusions of this study suggested that this situation could have a detrimental long-run effect on the organization:

> While it is not surprising to find that the more aggressive, self-confident men are leaving, there is no similar strong reason to expect that the men with more broad-gauged interests and abilities than the average engineer should leave.

---

* Ibid., p. 95.

† Ibid., p. 84

> Perhaps assignments or opportunities could be found for some young engineers which are just as interesting and challenging to the man with broad-gauged interests as most present assignments are evidently to the man with a strong orientation toward the more routine, down-to-earth engineering work. The broad-gauged men may very well be our future general managers.*

The Loomba study of engineers and scientists laid off in the San Francisco Bay Area found that the age of the respondents was the only factor that differentiated them from the engineers and scientists who remained with their various companies--those who left tended to be younger. As far as educational background, number of engineering and scientific courses completed since achieving highest degree, technical publications, patents, and membership in professional societies were concerned, there were no significant differences between those who were laid off and those who remained with their companies.† At least there is no reason to believe that those who left were any less capable than those who remained, and the fact that those who left were younger would cause one to speculate whether they might be more aggressive, on the average, than those who stayed. Although it is recognized that layoff policies commonly require junior employees to be laid off before senior employees, layoff policies do not ordinarily prevent an employer from laying off technically less competent employees among professional-level personnel.

The Shapero-Howell-Tombaugh study of the defense-related R&D industry reported that engineers and scientists with Ph.D. degrees had the highest turnover rates in four out of five areas studied (in Boston, Denver, Tucson, and Orlando, but not in Los Angeles).‡

One way to interpret these kinds of findings is to categorize them as examples of "constructive turnover" in the sense that they may reflect the attempts of organizations to get rid of highly educated and/or highly motivated individuals that these organizations cannot employ to their full

---

* See H. H. Meyer, and S. Q. Cuomo, Who Leaves? A Study of Background Characteristics of Engineers Associated with Turnover (New York: General Electric Company, Behavioral Research Service, 1962), p. 3.

† See Loomba, op. cit., p. 29.

‡ See Shapero, Howell, and Tombaugh, op. cit., p. 48.

capacity. The other way to interpret them, however, is to acknowledge that they could reflect a basic inability in these various kinds of employing organizations to utilize high talent and high energy in their employees appropriately. The latter interpretation presents additional challenges for organizational design or redesign.

Relevant to the discussion here is consideration of the argument that no turnover at all is unhealthy in organizational life, even though one recognizes the contrary situation--that excessive rates of turnover are also undesirable. Many maintain that an organization that lacks "new blood" can "grow stale" over time. Is there any evidence that this is true? And if true, how long does it take an organization without any turnover to begin to "grow stale?"

Donald Pelz and Frank Andrews have presented evidence showing that R&D organizations tend to decline in productivity over time, without the addition of new personnel. More specifically, they found that in 83 R&D groups, there was a general decline in the production of contributions to scientific knowledge as group age increased. On the other hand, they found a somewhat different pattern for ratings of the overall usefulness of group efforts from the standpoint of their employing organizations. Their evidence had indicated that the usefulness of R&D group outputs tends to increase up to about four or five years and then begins to decline steadily for the same group of scientists or engineers working together for longer periods of time. In association with these patterns of productivity over time, they found that members of older groups tended to become more communicative with each other, but also less competitive with each other and also more specialized in their interests and activities.* ("Overspecialization" can be considered to be one way to reduce interpersonal competition.)

As was pointed out in Chapter III, a general conclusion from all of Pelz and Andrews' studies has been that group productivity is maximized when there is a proper balance between security (as supported by favorable kinds of communication) and challenge (as supported by competition). Apparently older groups of scientists and engineers tend to develop an imbalance in these two items; they tend to become security-oriented at the expense of providing new challenge and stimulation for group members.

---

* See Pelz and Andrews, op. cit., Chapter 13. Pelz and Andrews' findings on the declining productivity of R&D groups in terms of contributions to scientific knowledge as group age increases correspond to earlier findings of H. Shepard in a study of 21 industrial laboratories; see "Creativity in R&D Teams," Research and Engineering (October 1956), pp. 10-3.

On the other hand, Pelz and Andrews' findings also suggest that it takes about four to five years of interaction, on the average, for technical professional personnel to develop the patterns of communication with each other that will allow them to become most productive in terms of the usefulness of the outputs of their employer. This coincides with my own findings that scientists (and perhaps other employees also) tend to go through two significant decisions in developing commitment to an employing organization. The first is "the decision to join" the organization, which is made at the time of entry. The second is "the decision to stay" in the organization, which tends to come about five years later, after a period of adjustment and doubt about organizational commitment during the first four or five years of employment.* It is reasonable to assume that an individual's full potential for making useful contributions to an employing organization does not develop until he has made this "decision to stay." But at the same time, the available evidence also suggests that if a scientist decides to stay in a group context that is made up entirely of people who have been associated with each other for five years or more, he will begin to experience a declining degree of challenge in this context. This, in turn, will induce decreased productivity both in terms of organizational usefulness and scientific value.

One could jump to a further conclusion that it is therefore desirable (from an individual security-challenge standpoint, as well as from the point of view of organizational productivity) for technical professional personnel to change their group context of employment somewhere in the neighborhood of once every five years. Translated into organizational turnover rates, this would imply that an annual turnover rate among technical professional personnel of about 20 percent would be most desirable, assuming that each individual would have an opportunity to participate in this rate (i.e., leave one group context for another) about every five years.

We can see at once that such a turnover rate is much higher than the reported turnover rates in many establishments at present. Nevertheless, an annual turnover rate of 20 percent is not uncommon among the highly

---

* These findings are discussed in a variety of papers by H. M. Vollmer, including "Toward a 'Two-decision' Theory of Organizational Conflict and Commitment," (a paper presented at the College on Management Psychology of The Institute of Management Sciences, Monterey, California, April 16-18, 1967);"Organizational Socialization among Scientists," presented at the annual meeting of the American Sociological Society, San Francisco, California, Sept. 28-31, 1967; and Adaptations of Scientists and Organizations, Chapter VIII, "Organizational Socialization."

dynamic companies in the defense-related R&D industry. While the Engineering Manpower Commission of the Engineer's Joint Council has reported an average annual turnover rate for engineers and scientists in high technology industries (aircraft and parts, communications, electrical-electronics, instruments, and R&D) of 12 percent, the same Commission found an average turnover rate for technical professional personnel in other less technically based industries of 8 percent.* In contrast, the Shapero-Howell-Tombaugh study of the defense-related R&D industry found annual turnover rates in excess of 20 percent in many establishments.†

There is no evidence that these higher turnover rates inhibit the successful operation of dynamic, high technology enterprises. On the contrary, it would almost seem that the more complex the technology with which an enterprise may have to deal under intensive production pressures, the higher the turnover rate is likely to be. Yet one must still recognize that extremely high turnover rates may reduce organizational effectiveness--but beyond some point that cannot be determined precisely. For the lack of evidence to the contrary, we could hypothesize (based on the Pelz-Andrews findings) that the optimal turnover rate could be in the neighborhood of 20 percent.

Such "constructive turnover" need not all come from employees leaving a company, however. Much of it might beneficially derive from in-company transfers from one group or department to another. Yet opportunities for internal transfer are distinctly limited in many organizational contexts. Impressions gained during the SRI studies of research organizations have indicated that it is often easier for research scientists to obtain a position in an outside organization than to transfer from one group to another within an organization. Sometimes this results from a desire to avoid competition between one group and another where scientists with strong capabilities are seeking internal transfer. Other SRI studies have indicated that corporate management is often reluctant to transfer engineers from defense work to commercial work within their same companies, on the assumption that extensive retraining would be necessary.‡ But in a later study, no evidence has been found to give any

---

* Engineering Manpower Commission of Engineers Joint Council, Demand for Engineers (New York: E.M.C. of E.J.C., 1962), p. 18.

† Shapero, Howell, and Tombaugh, op. cit., p. 44. This study found annual turnover rates in different establishments varying between 6 and 42 percent.

‡ See M. L. Weidenbaum and A. B. Roset, Potential Industrial Adjustments to Shifts in Defense Spending: an Analysis of a Reduction in Strategic

substantial support to this management assumption.* Finally, R&D managers tend to agree that it is easier for scientists to transfer from basic research activities to applied research and development activities, rather than vice-versa, mainly because of a loss of professional versatility along the lines described in Chapter IV. In all these situations and others, there are indications that increased internal transferability would benefit the employing organizations.

In summary, it could be suggested that the harmful loss of technical talent to other organizations could be alleviated by organizational design considerations oriented toward the following elements of "constructive turnover" among personnel:

1. A total technical professional turnover rate for the organization (combining internal transfers and external losses) that does not deviate far from 20 percent annually.

2. A rate of internal transfer that is at least equal to, and preferably exceeds, the rate of external losses.

3. A continued monitoring of the actual and potential abilities of those who leave the organization with the object of assuring that the abilities of those who leave are inferior to the abilities of (a) those who remain and (b) new hires.†

Where such policies would be implemented in organizational structures, we could expect an organization to grow in vitality. Where such policies are not followed, we could expect organizations that depend on highly technical talent to decline in productivity along the lines that several studies have indicated. In the latter case, abler employees leave and the less able stay and have an effect analogous to the process of sediment building up over time in a water tank that is not properly drained.

Programs (Menlo Park, Calif.: a Stanford Research Institute report to the Department of Defense, Office of the Director of Defense Research and Engineering, 1963).

* C. Rittenhouse, The Transferability and Retraining of Engineers (Menlo Park, Calif.: a Stanford Research Institute report to the U.S. Arms Control and Disarmament Agency, 1967).

† A further discussion of turnover is available in H. M. Vollmer, "Is Turnover a Good Thing?" (Menlo Park, Calif.: Stanford Research Institute, a luncheon address before the 15th Annual Joint Engineering Management Conference, San Francisco, October 9-10, 1967).

Policies oriented toward "constructive turnover" can thus work in the direction of organizational renewal. In contrast, "destructive turnover" results in organizational ossification and eventual death.

The Underutilization of Potential Talent*

Another sense in which employing organizations may be regarded as wasters of talent relates to underutilization of potential manpower resources. This can take place in two ways. The first is underutilization of segments of the labor market because of special worker characteristics (unrelated to specific job requirements) that are considered by employers as handicaps to effective performance. The second is underutilization of untrained manpower that could be effectively used by the organization both to produce the company's product and to help develop an expanded labor pool, if suitable training or job restructuring were accomplished. In this section, both kinds of underutilization are examined along with some implications for organizational design.

If skilled manpower were always readily available, if turnover rates were always at the same optimal level, if organizations never lost vitality and effectiveness, and if an employing organization could be considered as an entity detached from its social milieu, there would be little need for concern with the way organizations deal with labor pools. Unfortunately, no organization exists either in an economic utopia or separated from the social problems of the time. For these reasons, thought must be given to the conservation and development of the manpower resources from which all employers must ultimately draw their working staffs.

All employing organizations must be discriminators of talent, because of the highly specialized and competitive nature of work in the industrialized society of the United States. Discernment with respect to talent is exercised at the time of hire, in measuring and rewarding performance, and at the time of separation (although sometimes ineffectively, as was pointed out in the previous section). Moreover, talent is distinguished for purposes of specific job assignment and for more general organizational considerations or for societal reasons. It is also distinguished to meet immediate demands, contingencies of the near future, or for long range purposes.

---

* The analysis in this section and the following two sections is by Richard Hirshberg.

It is the contention of this section that certain general and longer range considerations tend to suffer in discriminating among potential hires, that the result is underutilization and consequent waste of manpower resources, and that improved organizational design in the manpower sphere could do much to change this.

For example, at a large research establishment on the West Coast, 44 percent of the entire staff are classified as "professionals" and 71 percent as "manager/administrators, professionals, and supporting technicians." Three percent of the entire staff are of the Oriental race. Of the Oriental employees, however, 77 percent are manager/administrators, professionals, and supporting technicians. Of the remaining 23 percent, almost one-half are skilled craftsmen and office workers. Approximately one-fourth of the Oriental workers are women, and their jobs are distributed in different occupational categories about as favorably as Oriental men.

The actual number of Oriental professionals in this organization--48--appears small when compared with the total professional staff of over 1,300; yet 48 highly trained scientists and engineers in this time of professional shortage represents a manpower resource of considerable value. At current research organization annual budgeting levels, it could be considered to represent the essential core of a research organization doing $3 million of work annually.

An indication that these figures are not unusual can be seen from the fact that of the 135,000 Chinese men in the United States in 1960, the professional manpower per thousand were 26 for engineers and 5.0 for natural scientists. Comparable figures for the caucasian male population were 10.8 engineers and 1.7 natural scientists.*

It can be argued that had this contribution to the labor pool not come from Orientals, it would not have come at all and that the national scientific and engineering establishment would probably be operating under a higher average salary level, lower numerical manpower level, and reduced or retarded output. In general, it may be hypothesized that this situation would result wherever high demand skills are in short supply, when appreciable occupational training is necessary, and when expansibility of wage rates is limited by overall economic consequences. The reverse may also be argued; that if a segment of the population is

---

* See P. H. Abelson, "Mainland China: An Emerging Power," Science, Vol. 157, no. 3787 (28 July 1967), p. 373.

effectively limited in its participation in a high skill, high demand, short supply labor pool, a removal of these limitations could increase the manpower resources and economic output (or level of development) by an amount equivalent to the normally expected ratio of that work force. This presumes that relevant population segments (for example, women, Spanish-speaking people, Negroes) are basically as talented and potentially as effective as normal labor pool occupants, even though these groups may not currently be trained for high skilled jobs. This assumption is hard to challenge on any reputable grounds. Certainly the experiences of the Soviet Union in utilizing women professionals, especially in the medical, scientific, and engineering fields, lend weight to this assumption. Moreover, American experiences with Oriental scientists and engineers would hardly be believed by those caucasian Americans of the 19th century who saw the Oriental capabilities only as coolie laborers, laundrymen, and cooks.

Let us examine the growth of women in the American workforce in some detail, keeping in mind that not many decades ago the woman's prime social and economic assignment was to the home. Even today, the major revolution in workforce participation by women is not generally comprehended.

The example is directly relevant, for in the words of President Johnson:

> The underutilization of American women continues to be most tragic and the most senseless waste of this country. It is a waste that we can no longer afford. Our economy is crying out for their services. In the next decade alone we will need 900,000 additional school teachers and college instructors; 1 million additional specialists in the health services; 800,000 additional science and engineering technicians; 700,000 additional scientists and engineers; and 4-1/2 million additional state and local employees, exclusive of our teachers.
>
> The requirements in these fields alone will be 110,000 additional trained specialists, every month for the next 10 years. That requirement cannot be met by men alone . . .*

---

* Federal Woman's Award Study Group on Careers for Women, Progress Report to the President (Washington, D. C.: Federal Woman's Award Study on Careers for Women, March 3, 1967), p. 7.

Table 1 shows the general trend in female participation in the labor force over three-quarters of a century. During that span of time, women have gone from about one-sixth to more than one-third of the labor force. Today almost two out of five women are in the labor force, more than double the figure of three-quarters of a century ago. Moreover, one-half of this change has occurred in the last 25 years, and there are no current indications of a slackening pace.

The reasons for this remarkable change are described elsewhere;* the importance from the point of view of the employing organization is in terms of the potential impact of women on the labor market and the opportunities for conservation and development of specific occupational segments it affords. The dramatic nature of this impact over the last 20 years can be seen from Figure 1.

The potentialities for growth of the women labor force are evident from an examination of the Womanpower Reserve for the United States.† No matter what reasonable exclusions are made (such as excluding teenagers and young adults in school, mothers of young children, and elderly women), the number of women in the labor reserve exceeds that of men. The inescapable conclusion is that future potential impact is high.

On what basis can it legitimately be held that woman power is being underutilized or wasted by employer organizations? Let us examine some pertinent facts.

1. More than one-third of all married women are workers, and, conversely, nearly three out of five women who work are married and living with their husbands.

2. The educational attainment of women workers is roughly comparable to that of men workers.

3. In general, women receive lower wages and salaries than men.

---

* See U.S. Department of Labor, Women's Bureau, 1965 Handbook on Women Workers, "Bulletin No. 290" (Washington, D.C.: Government Printing Office, 1965), p. 7. See also S. H. Garfinkle, et al, "Work Life Expectancy and Training Needs of Women," Manpower Report, No. 12 (May 1967), pp. 1-10.

† See, for example, S. Saben, "Work Experience of the Population in 1963," Monthly Labor Review, Vol. 88 (January 1965), pp. 8-16 and A1-23.

Table 1

WOMEN IN THE LABOR FORCE, SELECTED YEARS, 1890-1965
(Women 14 years of age and over)

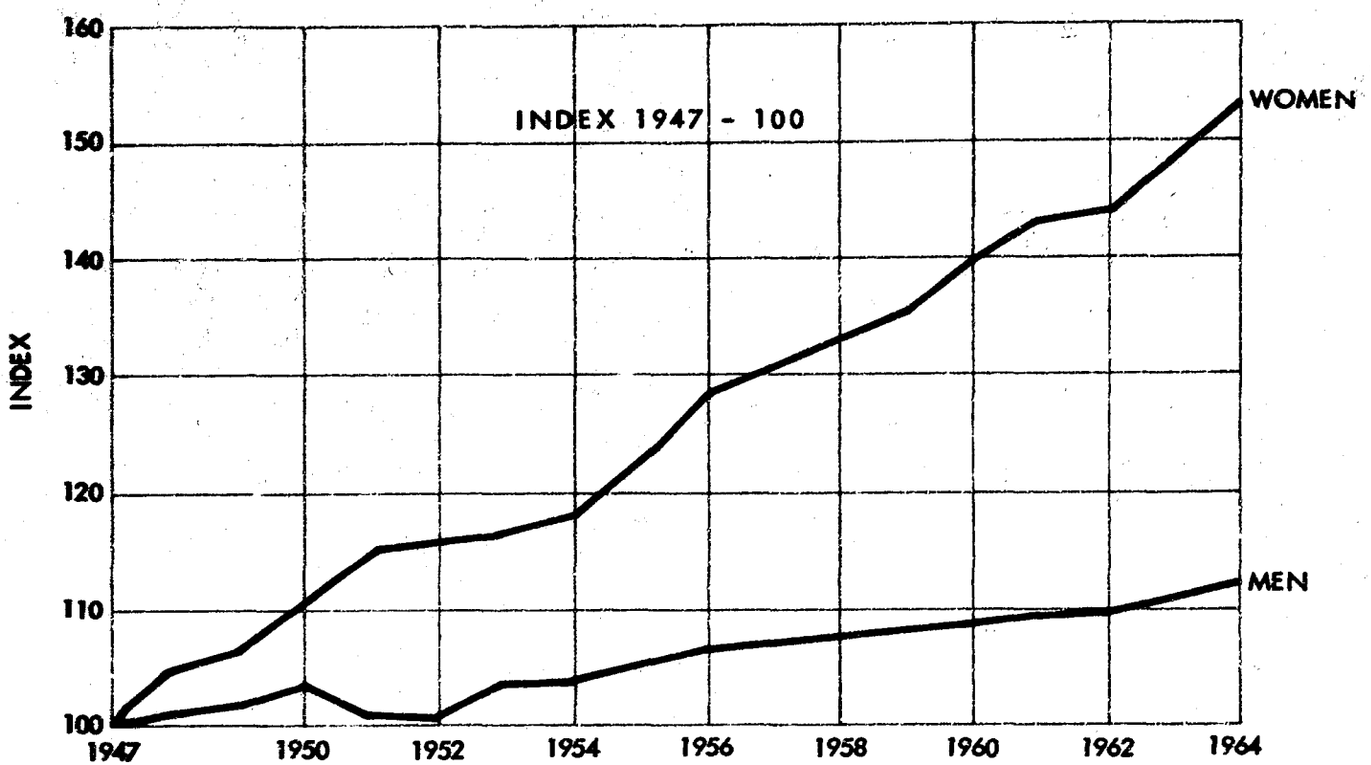
Year	Number	As Percent of All Workers	As Percent of Woman Population
Highlights*			
April 1965	26,108,000	35.0	37.3
Start of the sixties (April 1960)	23,239,000	33.3	36.3
Midfifties (April 1955)	20,154,000	31.2	33.8
Korean conflict (April 1953)	19,296,000	30.6	33.1
Pre-Korean conflict (April 1950)	18,063,000	29.0	32.1
Post-World War II (April 1947)	16,320,000	27.6	30.0
World War II (April 1945)	19,570,000	36.1	37.0
Pre-World War II (March 1940)	13,840,000	25.4	27.6
Long-Term Trends†			
1930 (April)	10,396,000	21.9	23.6
1920 (January)	8,229,000	20.4	22.7
1900 (June)	4,999,000	18.1	20.0
1890 (June)	3,704,000	17.0	18.2

* Civilian labor force.
† Decennial census (total labor force).

Source: Reprinted from U.S. Dept. of Labor, Women's Bureau, 1965 Handbook on Women Workers, "Bulletin No. 290"(Washington, D.C.: Government Printing Office, 1965), p. 6.

Figure 1

RELATIVE GROWTH OF THE LABOR FORCE, BY SEX
1947-1964



SOURCE: U.S. Department of Labor, Women's Bureau, 1965 Handbook on Women Workers, p. 12.

4. The age distribution of women workers differs from that of men; it is bimodal* because of the entry-re-entry pattern of women workers into the labor force, which is correlated with childbearing and child care.

5. Women as a class have a long work-life expectancy despite a childbearing-child care period during the early years of marriage; moreover, there is a relatively long work life expectancy for mature women who return to the labor force.

6. Men and women have different occupational distributions, for the most part unrelated to physical differences.

These facts and other available information reflect differences in the economic role connected with woman's procreative life and socially defined family responsibilities. The picture also reflects a situation where employing organizations adopted an implicit manpower policy in the past that accepted women as a class of workers not only different from men, but also whose right to employment was basically less meritorious. In so doing, employing organizations tended to view women both in terms of highly specific job assignments and of meeting immediate organizational demands. The resulting manpower practices have, in consequence, tended to retard women's opportunities within the organizational framework, as well as retarding increased educational attainment and manpower pool growth in high skill-high demand occupational areas. It is in this sense that employer organizations may be said to have sacrificed longer range considerations and wasted or underutilized potential manpower, rather than encouraging the full self-expression and development of this "woman power" resource.

Currently, despite federal and state laws directed at encouraging equal employment status for women,† employing organizations have tended to view adjustments as a matter of complying with minimum legal requirements rather than as an opportunity for corporate and national benefit. For such benefits to accrue, innovation in manpower planning is required at the company level. This innovative thinking must view the conservation and development of manpower resources as inseperably linked to the

---

* Labor force participation as a percent of all women in the respective age classes.

† See U.S. Department of Labor, Women's Bureau, 1965 Handbook on Women Workers, "Part II - Laws Governing Women's Employment and Status," pp. 226-58.

organizational design of companies. In the following pages some implications of the foregoing facts will be presented, and directions that may be taken in organizational design will be indicated. These will consist largely of manpower arrangements in the company for recruitment and training, job composition, direct and indirect employee benefits, and elaboration of manpower policy.

Employer Opportunities for Utilizing Women

One implication of the facts that have been recited earlier is that women are willing to work for pay, that the requirements of the American family structure are changing to fit job opportunities for women, and that this willingness of women to work for pay has contributed to the growth of business and industry and the satisfaction of new markets.

By and large, adult Americans want the improved living satisfactions that come from an increased ratio of family income to living costs. Employers may view this as the equivalent of a long term American value system commitment to economic growth. If, as may be supposed, the key limitation to such growth is a large pool of well-trained manpower rather than markets, an advantage accrues to those employer organizations that first learn how to tap underutilized or fresh manpower resources (such as women) and to develop and maintain these resources by integrating the new worker treatment and utilization concepts into their total manpower management mechanisms.

It can also be argued that an increase in the size of a labor pool, such as by an increase in qualified women workers (with equal male/female wage treatment and without expansion or compression effects on the total pay scale) would result in advantages to the employer. The company could be more selective in hiring, promotion, job rotation, and so on and thereby obtain the direct benefit of increased productivity (in quantity or quality). The company would also profit indirectly through increased consumer demand as a result of an increase in the family consumption level.

Differing positions can be taken with respect to these and other arguments. Whatever the position, however, the manpower policies practiced by large employers affect occupational skill pools for years to come. The power to control vast resources is the power to affect the society at large; this social effect cannot be lessened by being ignored.

Increasing attention by both corporate executives and professional students of labor management is being devoted to the role of top executives in business and industry as "socially conscious" decision-makers,

reflecting the basic social responsibilities of employing organizations. If manpower policies of the company are evaluated within this context, a strong case can be made for sharing the responsibility for conservation and development of manpower resources with governmental authorities.

Since it is fair to say that the U.S. family structure has readily adapted to increasing employment opportunities for women,* the factors of corporate advantage and overall concern for manpower should dominate in reconsideration or redesign of a company's policies concerning employment of women.

A second implication of the facts presented earlier is that there is a great deal of organizational leeway for employers to adjust employee treatment patterns and work process patterns to the dynamics of the family structure, thereby opening job opportunities to women now unable to enter the labor force, either partially or fully.

Such factors include providing skill refresher and retraining opportunities for mature women labor force re-entrants, providing special services for employees with young children, and innovative work scheduling (and work hours) to match family care requirements. Job restructuring, either in connection with the above factors or by itself, is a potentially important design technique for matching the requirements of the company to the dynamic patterns of the woman's role in the family.

There is a long history of matching job content with worker talent, or task breakdown with skill level, in U.S. industry. The important point here is the recruitment benefit to be gained when work restructuring allows increased labor force entry to an appreciably underutilized population segment. Innovative approaches are limited only by declining efficiency or increased cost of the total operation. From the national point of view, an overall gain may be achieved through job restructuring

---

* Numerous arguments for protecting the husband, the home, the family, and the child from the threat of the working woman have been shown to be misrepresentations or exaggerations of opinion or fact. From a sociological or phychological benefits point of view, the net consequences of the increasing employment of women appear to be largely neutral or indeterminate; positive and negative consequences have been only inconclusively demonstrated. For an extensive list of relevant studies see A. S. Rossi, "Equality Between the Sexes: An Immodest Proposal," in Daedalus, Vol. 93 (Spring 1964), pp. 607-652.

even if employer organizations suffer a small degree of decreased efficiency or increased cost, providing that the per unit degradation is offset by turning underutilized or nonworkers into more productive members of the workforce. Under such circumstances, it is even possible to subsidize the employing organization for the marginal increase in cost of job restructuring, where it can be held that the public interest is being served in the long run. This kind of public/private partnership in the national interest has many precedents and also applies to all of the other considerations under discussion--training, special services, and innovative work scheduling. Thus, part of the organizational design implication is the acceptance of a certain degree of partner relationship relating to treatment of special segments of the labor force, so that no competitive advantage will accrue to nonparticipant employers, and with the ultimate improved condition of the labor force as the final objective.

However, no competitive disadvantage or public/private partnership arrangement need necessarily exist in implementing any of these employee treatment or work pattern adjustments. For example, occupational and skill shortages in the health service field have now become so acute that numerous job and task restructuring proposals have already been made and, in many instances, acted on. What is required is the foresight to act on shortage situations before they become crises; and the vision and imaginativeness to see new patterns in untapped manpower and overall work requirements even where current shortages do not exist. Innovation in this segment of manpower design can be just as profitable as from any other kind of inventiveness; an excellent case in point can be found in Liberty Ship construction during World War II.

A third set of implications of the facts presented earlier is that today's women workers are heirs to wage and salary treatment that for decades has discriminated against women, not for reasons of talent, but because they are women. This kind of discrimination unrelated to specific job requirements has reduced both the ability and the incentive of women to improve even further their educational attainment and to enter into the labor force in even larger numbers. It has also had an especially retarding effect on entry into those high skill, high demand professional occupations described earlier by the President.

The extent to which salary inequities exist between men and women workers has been documented many times, but, for an example, consider the case of nurses. A reasonably complete picture of the low financial returns of this profession on both an absolute and a relative basis can easily be documented from public statistics. This is demonstrated in Table 2, which gives pay scales for the full range of this high skill,

Table 2

MEDIAN WEEKLY SALARIES* OF WOMEN IN SELECTED HOSPITAL† NURSING OCCUPATIONS

Metropolitan Area‡	Directors of Nursing	Supervisors of Nurses	Head Nurses	General Duty Nurses	Nursing Instructors
Atlanta	$ --	$ 89.50	$ 81.50	$75.00	$ 85.50
Baltimore	132.50	101.50	93.00	81.00	106.00
Boston	164.00	109.50	101.00	86.00	107.50
Buffalo	--	119.00	108.00	91.00	112.00
Chicago	157.00	116.50	103.00	93.00	114.50
Cincinnati	--	118.50	98.50	85.50	99.50
Cleveland	150.00	120.00	108.50	93.00	114.50
Dallas	--	101.50	92.50	83.50	--
Los Angeles-Long Beach	160.50	117.50	109.00	94.50	116.00
Memphis	--	--	87.50	75.00	93.00
Minneapolis-St. Paul	165.00	117.00	105.00	89.50	104.00
New York City	177.50	116.00	109.00	95.50	120.50
Philadelphia	155.00	100.00	91.00	79.50	102.50
Portland (Oreg.)	--	107.00	95.50	87.50	--
San Francisco-Oakland	161.50	124.00	113.50	93.50	123.50

* Weekly salaries are straight-time earnings excluding extra pay for work on late shifts, as well as value of room, board, or other perquisites, and are rounded to the nearest half dollar.

† Covers those in nongovernment hospitals.

‡ For 15 metropolitan areas in mid-1963.

Sources: Reprinted with minor modifications from U.S. Dept. of Labor, Women's Bureau, 1965 Handbook on Women Workers, "Bulletin No. 290, p. 155.

high training, high responsibility profession. These low salary scales for nurses are only recently being corrected--through collective bargaining pressures in many cases.

For another example, it can be shown that the salaries of women scientists and engineers are far below salaries of men for comparable educational degree and age categories--in certain instances, 30 percent or more below. Obviously, one way for employer organizations to help correct certain manpower shortages relating to women is to redesign inequitable wage and salary scales.

Motivation and education can be discussed together since they are closely connected. The objective is to "free" one segment of manpower (in this case women) within the environment of the company so that the increased life and vitality generated in this segment spreads to the underutilized manpower source--with a resulting, long run expansion of the labor pool as increased employment opportunity is realized. This is basically recognizing that a strong latent force for growth exists and then providing one of the conditions (increased opportunities) for its release. We have already indicated some of the inferential basis for believing that such a latent force exists. A further indicator can be found in the growth of advanced degrees since 1900.* In 1900, 6 percent of all degrees earned by women were at the advanced degree level; by 1930, this figure had increased to 12 percent and stood at about 15 percent between 1950 and 1965. For men, the corresponding figures were 7 percent in 1900, 13 percent in 1930, and rose to 22 percent by 1965. The increasing utility of advanced degrees in business and industry following World War II contributed to the rapid growth in the acquisition of advanced degrees by men. Women's past history of degree acquisition shows that they would quickly again approach the male advanced degree level, given increased incentive and opportunity.

It is impossible for employing organizations to carry out a coordinated national program to vitalize the expansion of a segment of the labor force. It must be realized, however, that when discrimination in salaries and advancement exists in high-skill/high-demand occupations, there are fewer incentives to continue on for advanced training. The employing organization's contribution can be to make it evident <u>through explicit manpower actions</u> that the full range of employment opportunities

---

* See U.S. Department of Labor, Women's Bureau, <u>Trends in Educational Attainment of Women</u> (Washington, D.C.: Government Printing Office, June 1967).

for women are there, and then to join with governmental, foundation, and educational agencies to tune the educational process and work practices to a single working harmony. Granting that the employing organizations have "freed" opportunities, then the other partners responsible for manpower resources can expand their current efforts to design appropriate curricula,* reformulate images, provide financial support, and so on.

A fourth implication of the facts presented earlier is that employer organizations have room for expanding job opportunities for both women and men wherever rationally unjustifiable sex dominance of an occupational field exists and that radical technological or organizational innovations in the clerical and home service areas could lead to male/female manpower adjustments of major proportions and of major benefit to the nation at large.

At a recently concluded conference, the Second International Conference of Women Engineers and Scientists held in Cambridge, England, The Soviet Women's Committee is reported to have presented the following figures: ". . . women make up 6 percent of the USSR's directors of industrial concerns, 16 percent of chief engineers, 12 percent of shop managers, 22 percent of shift managers and laboratory chiefs, 20 percent of foremen, 62 percent of rate fixers, and 79 percent of engineer-economists, planners, and statisticians."† It has also been pointed out that women constitute about one in three of the professional engineers in the USSR; about one in fifty in France; less than one in a hundred in the United States; and less than one in a thousand in the United Kingdom. It is obvious from these figures and other data that women's potential in the engineering disciplines is high and that their participation rate depends primarily on social--not biological or psychological--factors.

---

* For example, it may be more important (on the average) for women than for men to pursue curricula with a generalist orientation, and also with a futurist orientation, so as to ease the further learning and retraining problem that re-entry into the labor force implies. Such a view would anticipate forestalling occupational obsolescence before it has set in (see Chapter IV).

† M. Neal, "Technical Women," International Science and Technology, no. 69 (September 1967), pp. 13-20.

In view of the fact that the Engineering Manpower Commission estimates a shortage of almost 30,000 engineering graduates each year over the next decade,* it is clear that American women offer one of the best potential sources for filling the gap.

A recent description of the situation in chemical engineering, the engineering discipline with the largest number of women (approximately 1,200 out of 125,000 engineers), summarizes the problems, potential benefits, and some steps to be taken to increase women's participation in that field sharply.† The most important implications from the point of view of this chapter is that wide discrepancies in occupational ratios of the sexes are more often than not socially rather than biologically determined and that recognition of this fact can be turned to the advantage of the company through active recruiting and prerecruiting activities.

We consider now some potential effects of technological and other changes on worker ratios by sex. About 98 percent of stenographers, typists, and secretaries are women. Suppose, however, that the technical aspects of going from the spoken or handwritten word to machine copy become fully automated; that transmitting and receiving textual information becomes a pushbutton, desk-top function; and that establishing telephonic contact and associated protocol control becomes fully programmed for an electronic-switchboard. It becomes clear that the stenographer-typist-secretarial function moves more closely toward a technical orientation. The strictly feminine character of the occupation and relatively low clerical wage rates both might change under such circumstances; new job configurations are also likely possibilities.

It will obviously be some time before such changes occur (although much applicable research work is currently under way). However, innovative forays into the organizational aspects of such man-machine relationships might pay rich dividends for corporations of sufficient size and with applicable operations.

Other innovative forays into the home service area by appropriate employing organizations might also yield surprising dividends. For example, the design of employee reward structures seldom intrudes as far

---

* An average demand of 69,000 per year compared with an average supply of 41,000 per year.

† See H. Popper, "What You Should Know About Women Engineers," Chemical Engineering, Vol. 74 (September 11, 1967), pp. 165-72.

into the social fabric as providing housing and home services for the family unit. The concept of company housing would appear to have had its day. However, the unsatisfied demand for trained household workers (it has been estimated that 10 potential consumers are competing for every available domestic worker) is only one of many indicators of the sociotechnical gap in meeting perceived home service needs. Various economic solutions to this problem have been proposed. One in particular, the creation of a professionalized home service industry--estimated to have a market potential of $1.5 billion per year--could lead to male/female manpower adjustments both by freeing additional women (who are currently constrained to the home) for the work force and by shifting a predominantly female service occupation to a different sex ratio balance. Quite apart from such overall economic solutions, employing organizations might well re-examine the potential manpower gains that might be achieved by providing various forms of family housing and home service benefits. This is especially so in view of recent Department of Labor statistics that show a surprisingly high degree of occupational similarity between working husbands and wives.

Employer Opportunities for Utilizing Negroes

Women have been used as an example of the relationship between underutilization of potential manpower resources and organizational design. Other segments of the nation's manpower could also be analyzed to bring out this relationship with somewhat different results. For example, the participation of Negroes in the nation's workforce is now a matter of vital concern everywhere. Here, the crucial facts* are quite different from those given previously for women, and the implications of these facts are also different. For example, there is no good evidence to indicate that the Negro family structure has been much in harmony with the driving economic themes of our society or that employer accommodation to some common current forms of this family structure will yield long term manpower payoffs.† There is, moreover, a complex relationship among housing,

---

* See E. Ginzberg and D. L. Hiestand, "Employment Patterns of Negro Men and Women," and A. F. Brimmer, "The Negro in the National Economy," in J. P. Davis, ed., The American Negro Reference Book (Engelwood Cliffs, N.J.: Prentice Hall, 1966).

† See H. Lewis, "Culture, Class, and Family Life Among Low-Income Urban Negroes," in A. M. Ross and H. Hill, eds., Employment, Race and Poverty (New York: Harcourt, 1967); D. P. Moynihan, "Employment, Income, and the Ordeal of the Negro Family," and L. Rainwater, "Crucible of Identity: The Negro Lower-Class Family," in Daedalus, Vol. 94 (Fall 1965), pp. 745-70 and Vol. 95 (Winter 1966), pp. 172-216.

education, and employment, and there has been little development of the kind of entrepreneurial traditions so characteristic, for example, of Jewish and Oriental minorities.* These conditions hinder "take-off" when employment opportunities for Negroes are "freed" in the employer organization context. This implies a need for a heavier concentration on employing untrained manpower by means of suitable training and job restructuring; that is, a concentration on the second kind of under-utilization noted earlier.†

A critical factor in organizational design for the utilization of Negroes is that of time. Unlike the long term situation with women--who are mostly integrated into the main fabric of national life and have basic commitments to it--time has run out with American Negroes.‡ The historical drift, as well as current forces and circumstances, now leave the employer little choice but to increase and upgrade minority employment. The important questions are: To what degree can the adjustment of racial balance in the company be placed on a rational basis and what are the crucial, high-payoff techniques for accomplishing the changes? One thing is clear--employer organizations (in some form of partnership with other institutions)§ must be the "minority manpower entrepreneurs"; by and large, Negro aspirants for a better future do not have the organizational and motivational traditions to carry the main burden alone at this time.

---

* E. P. Foley, "The Negro Businessman," Daedalus, Vol. 95 (Winter 1966), pp. 107-44.

† See F. H. Cassell, "Jobs for the Hard-to-Employ in Private Enterprise," in F. H. Harbison and J. D. Mooney, eds., Critical Issues in Employment Policy (Princeton, N.J.: Princeton University, Industrial Relations Section, May 12-13, 1966). The papers and discussions of this symposium reflected the dominant themes of "emerging shortages and persistent surpluses, . . . occurring simultaneously in the American economy today." The relationship between these concerns and the treatment of under-utilization in this chapter are apparent.

‡ W. F. Soskin, "Riots, Ghettos, and the 'Negro Revolt'", in Ross and Hill, Employment, Race, and Poverty, pp. 205-33.

§ For a discussion of some aspects of this partnership see R. A. Lester, Manpower Planning in a Free Society (Princeton, N.J.: Princeton University Press, 1966), particularly Chapter 7, "The Economics of Manpower Planning and Operations."

Some of the design implications discussed earlier with respect to woman-power also hold for the Negro population segment, despite the different basic facts and implications. For example, the importance of innovation in the fields of in-house training and of partnership with out-of-house suppliers (and pretrainers) of manpower is even more crucial than for women in general. Moreover, joint mechanisms for funding such programs must be considered an integral part of the design. In general, it can be expected that more and more the training aspect of an employer's manpower organization will have to accommodate to individual characteristics of manpower segments. An imaginative approach, however, that recognizes the underutilized potential of each segment may yield the kind of generally unforeseen advantages that accrued to Ford Motor Company when it innovated Negro recruitment in the auto industry.

In summary, we have sought to show that underutilized manpower resources exist, that their potential is waiting to be tapped, and that mechanisms exist whereby employer organizations may change or redesign their manpower patterns to produce several benefits.* These benefits are to the nation, to employing organizations, and to individuals. To the nation, the benefit is a better balanced use of total manpower. To employing organizations, it is the conservation and development of needed manpower so that skill shortages may be reduced and demand for product and services increased, with consequent increase in growth and development opportunities for the company. To individuals, it means fuller sharing in the workings and in the fruits of modern life. "Good" organizational design, for full manpower utilization means the development of compromise manpower policies, patterns, and usages for the company that avoids, on the one hand, the kinds of underutilization discussed in this chapter and, on the other hand, avoids the kinds of overutilization discussed in Chapter IV. The manpower utilization and development units mentioned in Chapter III could play an important role in seeking ways to utilize these currently wasted reservoirs of potential talent profitably.

---

* Many of the ideas discussed in this section are reviewed within a total national manpower context in U.S. Department of Labor, Manpower Report of the President and Report on Manpower Requirements, Resources, Utilization, and Training (Washington, D.C.: U.S. Department of Labor, April 1967). See especially Part II, "Unused Manpower," and Part III, "Unemployment and Underutilization of Manpower."

Chapter VI

ORGANIZATIONS AS STIFLERS OF INNOVATION

Previous chapters have discussed the extent to which modern employing organizations misutilize individual talent--either by using it up without providing mechanisms for its regeneration or by failing to employ actual or potential resources of talent where these resources are available. In addition, to complete the picture of major deficiencies in organizational operation, we must make a closer examination of structural problems. Up to this point, we mostly have been examining manifestations of certain functional defects--those associated with a lack of congruence between organizational systems operations and the developmental needs of personality systems. Here we shall examine more specifically the consequences of the way in which organizational roles are commonly related to each other (i.e., organizational structure) for the capability of organizations to initiate and implement innovation. This is the acid test of the viability of modern organizations. In a rapidly changing world, these organizations that are not only capable of innovation, but are also conducive to innovation will survive. Those that are static and inflexible will die. Furthermore, it takes only a small jump of imagination to the conclusion that whole societies that are made up mostly of organizations that are not capable of innovation cannot be expected to survive.

This does not mean that innovations must always be originated within organizations. In fact, National Planning Association studies conducted by Sumner Myers have found that "two-thirds of 560 innovations . . . were adaptations"--i.e., the novel idea was originally developed in one industrial organization, but was eventually applied in another company.* Nevertheless, as Myers and others have recognized, organizations that are astute in the utilization of innovations are likely to possess certain structural characteristics, regardless of whether the innovations were originated within their own walls.†

---

* See S. Myers, "Industrial Innovations and the Utilization of Research Output," in Twentieth National Conference on the Administration of Research (Denver, Colo.: Denver Research Institute, 1966), p. 138.

† According to Myers, these include technical professional employees with a "cosmopolitan" orientation and the combination of "organizational bonds and spatial barriers"; Ibid., pp. 139-41.

James Q. Wilson has led a group of scholars in a notable examination and analysis of the structural factors in organizations that tend to inhibit innovation. In this analysis, "major innovations" were defined as "fundamental changes in a significant number of tasks"--while recognizing that a precise, a priori definition of these terms could not be made. Wilson and his associates pointed to examples where organizations had not produced major innovations in areas where they might have been expected, such as General Electric's failing to introduce the fluorescent lamp and Western Union's failing to introduce the telephone. Examination of such cases led to the conclusion that the organizational conditions that facilitate the conception and proposal of an innovation differ markedly from the organizational conditions that facilitate the adoption and implementation of the innovation. Innovations are more likely to be generated in a decentralized, nonroutinized organizational situation, but innovations are more likely to be adopted in a centrally coordinated structure.*

In this conclusion, these analysts appear to have put their fingers on a major organizational dilemma. "A prophet is not recognized in his own country" because a country that produces prophets is not likely to be organized so that it can put their ideas into action. Sputnik and subsequent technical accomplishments have disproved previous doubts that highly centralized socialistic systems can produce technical accomplishments rivaling those of more decentralized private enterprise systems. It may well be that the former have an advantage in implementing technical innovations, while the latter are more able to conceive them.

Wilson provides a pertinent description of these two aspects of innovation in city government, drawing on Chicago and New York as examples:

> How can one compare the innovative capacities of two city governments, one of which is characterized by a high degree of centralization, the other by a low degree? Chicago's government is informally centralized by a political boss whose machine has almost complete control of the incentive system of key members of the administration and of almost all members of the city council. New York has a city government that is decentralized; the formal, legal dispersion of power is not overcome by informal centralization under party auspices. Key administration members are

---

* See J. Q. Wilson, "Innovation in Organization: Notes toward a Theory," in J. D. Thompson, ed., Approaches to Organizational Design (Pittsburgh, Pa.: University of Pittsburgh Press, 1966), pp. 194-218.

> attracted by a wide variety of rewards over which the nominal head of the administration, the mayor, has little or no control, e.g., the possibility of an independent political career, of advancement to higher posts within semiautonomous boards and commissions, of conforming to internally valued or externally rewarded professional expectations and standards, of entering into alliances with civic associations and newspapers for whatever benefits they can bestow, and so forth. In New York, new proposals are constantly being generated by many persons within the administration; each proposal, however, "must run a gauntlet that is often fatal." There are literally scores of opportunities for others to intervene and register a decisive veto. In Chicago there is no such gauntlet; only the mayor's (i.e., the boss's) views count, and what he decides becomes policy. At the same time, relatively few proposals are generated within the administration; the real sources of innovations are private associations and groups that compete for the mayor's attention. (Such outside groups are also active in New York, of course, but there they can usually count on having a governmental agency or bureaucrat as their overt ally.) Whether Chicago or New York is more innovative depends on the result of the operation of these contrary tendencies.*

Thus, both forms of organizational structure--the centralized and the decentralized--can act as facilitators of one part of the process of innovation, but at the same time, can also act as inhibitors or stiflers of the other essential aspect of innovation. It is the stifling effects of organizational structure that we shall focus more attention on here, with some initial indications as to how these stifling effects might be overcome by more careful efforts in organizational design. To examine these considerations in more detail, we turn to a discussion of administrative, judicial, and general structural-functional factors relevant to the process of innovation.

Administrative Factors

Recent research has lent more support to the conclusion that it is not the most completely decentralized (i.e., the "most free") organizational situations that are likely to be most conducive to the generation

---

* See Wilson, op. cit., pp. 205-6. See also E. C. Banfield and J. Q. Wilson, City Politics (Cambridge, Mass.: Harvard University Press, 1963), Chapter 23.

of innovative ideas, but rather situations in which there is a high degree of individual discretion in work activities--but balanced by a moderate amount of contacts with, and influence from, "significant others" in the work environment. Thus, in their studies of factors conducive to scientific productivity, Pelz and Andrews found repeatedly that the most productive scientists were those who admitted that supervisors and colleagues had exercised some influence in their choice of research topics to investigate; these turned out to be more productive than either those who had acknowledged more, or those who had acknowledged less, influence from others.* This is reminiscent of the earlier findings of a group of psychologists that children tend to be more satisfied, productive, and creative in play groups under what the researchers then called "democratic" group structure (now called "participative"), than under either "autocratic" or "laissez faire" conditions.† It is these mixed kinds of situations--but with a greater relative emphasis on freedom than on control--that appear to be most conducive to the conception of innovations.

Looking at the other end of the process--the acceptance and implementation of innovation--we can also see that somewhat mixed organizational environments, rather than monolithic and completely centralized structures, are more conducive to innovative acceptance. While we would expect military and paramilitary organizations to be readily adaptable to new modes of operation introduced simply by fiat from the top of the structures, we know that history is replete with examples of resistance to change in such organizational environments. Similarly, while the Roman Catholic Church can be overtly responsive to liberal reforms introduced by a Pope John XXIII, there can be significant areas of resistance to change within the system, as is exemplified by the "traditionalist movement."

This is true because no organization can be completely monolithic or completely centralized; all organizations of any complexity whatsoever contain decentralized foci of power, and hence potential sources of resistance to change. Individuals who have served in various organizational

---

* See Pelz and Andrews, op. cit.

† For a summary of these studies, see R. Lippitt and R. K. White, "An Experimental Study of Leadership and Group Life," in T. M. Newcomb and E. L. Hartley, Readings in Social Psychology (New York: Henry Holt & Co., 1947), pp. 315-30.

roles for any period of time tend to resist new ways of doing things because they have developed a stake in doing things the old way; their status, security, and general self-image comes to be derived from the way in which they have played certain roles. Thus, numerous studies have shown that (1) the young (i.e., those who have not yet developed such a stake in particular organizational roles) and (2) more educated people (i.e., those whose status and self-image derives from readily-transferable knowledge and skills) are more amenable to accepting innovative changes.* Furthermore, the literature on the effectiveness of planned change in organizational contexts indicates that changes are more likely to be accepted in situations where organizational members have a sense of participating in the change process, or at least where the changes introduced do not undermine the incentive patterns that are attached to existing roles.† In sum, acceptance of innovation is facilitated in organizational situations in which centralization of decision-making predominates so that innovative decisions can be expected to be accepted without "running the gauntlet" of a multitude of decentralized power centers, but where groups and individuals affected by an innovative decision can be expected to accept the "legitimacy" of the innovation--that is, its congruity with existing role and status patterns.‡

The way that organizational administration is often set up contradicts one or the other of the above considerations. Organizations are often designed on a unity of command principle (i.e., "every man should have one

---

* See the review of the literature of A. Shapero reported in "Diffusion of Innovations Resulting from Research: Implications for Research Program Management," in Yovits, op. cit.

† For a review of this literature, see H. A. Shepard, "Changing Interpersonal and Intergroup Relationships in Organizations," in J. G. March, ed., Handbook of Organizations (Chicago: Rand McNally, 1965), pp. 1115-43.

‡ This principle is well illustrated by Burns and Stalker's findings from studies of the British electronics industry, indicating that in those companies most adaptive to innovation, information flows from R&D or marketing department sources directly to those parts of the production department where the information was needed to reprogram routine operations. In less adaptive companies, information barriers existed between these departments. Nevertheless, in the innovative companies it was found that various departments had a strong sense of shared identification with overall company goals. See T. Burns and G. M. Stalker, The Management of Innovation (London: Tavistock, 1961).

boss") and on a uniform profitability principle (i.e., "every unit should pay its own way" in the same payoff time frame) so that rationality is apparently maximized, but innovative capabilities are in effect minimized.

As Charles Perrow has suggested, there are particular forms of organization that are especially designed to process nonstandardized materials (material items, people, or symbols) and to use nonstandardized methods for handling these materials, while other forms of organization are set up to handle more standardized materials with standardized methods. There are also two other forms of organization to handle nonstandardized materials with standardized methods or standardized materials with nonstandardized methods as shown in Figure 2. Perrow suggests that a "flexible, policentralized" form of organizational structure characterized by negotiation and feedback of information, rather than formal centralized planning, is more characteristic of high quality, innovative production of nonstandardized materials by nonstandardized methods.* While we would agree that this form of organization is characteristic of situations in which innovations are likely to be conceived and proposed, we find no evidence that this is the form of organization in which innovations are more likely to be accepted and implemented.

What is needed is a description of a model of organization that facilitates both ends of the process of innovation--the initiation and the adoption. Such a model of organization must be a "mixed model"--it must include structural arrangements for the total organization that permit the processing of (1) nonstandardized materials by nonstandardized methods and of (2) standardized materials by standardized methods simultaneously. In effect, this requires a form of organization that deviates from the commonly accepted principles of unity of command and uniform profitability within the same time period.

---

* See Perrow, "A Framework for the Comparative Analysis of Organization," It should be noted that Perrow denies that he has proposed "four types of organizations" in his analysis; he maintains that he has described two cross-cutting dimensions (form of materials processed and method of processing) that can be applied to any form of organization for the purposes of comparative analysis. Nevertheless, for the purposes of designing organizational structures appropriate to different forms of technology, one must reconceptualize Perrow's variables in terms of forms of organizational structure.

Figure 2

DIMENSIONS OF ORGANIZATION ACCORDING TO TECHNOLOGY

		FORM OF MATERIAL PROCESSED	
		STANDARDIZED (few exceptions)	NONSTANDARDIZED (many exceptions)
METHOD OF HANDLING MATERIAL	NONSTANDARDIZED (large amount of discretion in application of rules to procedures, criteria for decisions, etc.)	DISCRETION: Managerial - low Technical - high EXAMPLES: Craft Production, Some Schools, Law Firms	DISCRETION: Managerial - high Technical - high EXAMPLES: Research, Individualized Tutoring or Therapy
	STANDARDIZED (preformulated rules to determine procedures, criteria for decisions, etc.)	DISCRETION: Managerial - low Technical - low EXAMPLES: Assembly Line Production, Custodial Institution, Military Academy	DISCRETION: Managerial - high Technical - low EXAMPLES: Routine Design, Programmed Learning School, Clinic or Hospital

SOURCE: Adapted with modifications from C. Perrow, "A Framework for the Comparative Analysis of Organizations," American Sociological Review, vol. 32 (1967), pp. 194-208.

Aerospace companies (which Perrow places in his high quality, innovative production category) are noted for the development of the matrix form of organization, in which project authority tends to be set up for particular projects that draw on technical professional personnel from different functional administrative departments. When assigned to projects, these personnel are in effect operating under dual authority. They obtain direction for project work from the project director, but they are well aware of the fact that they will be ultimately, if not immediately, accountable to administrators of functional departments. In such situations, every man is no longer subject to one "boss" alone. He has two (or more) "bosses" for different kinds of tasks--ie., supervision operating in specifically delineated, rather than generalized, roles.*

In essence, the technical professional personnel are placed in project team roles that are at least temporarily segregated from more permanent functional roles within the administrative structure--into segregated roles, but not into permanently isolated roles. Also, different performance standards (i.e., different criteria of profitability) may be required in the segregated roles.

What are the effects of organizational segregation on innovative productivity? Data are not generally available to answer this question conclusively, but some management experiences and data from studies of research scientists in organizationally separated versus organizationally integrated fundamental research activities begin to indicate some answers.

On the question of the organization of nonstandardized research activities, Jacob Goldman, the Director of the Scientific Laboratory of the Ford Motor Company, has written that organizations devoted to fundamental research can b quite useful to corporations that depend on rapidly changing technology, but that:

> Good research has to be cushioned. Perhaps I phrase it best if I say that good research must be insulated, but not isolated. It has to be insulated, or cushioned, because once people learn that they can utilize this talent to put out fires, to help solve immediate problems, then the research

---

* For a schematic representation of the matrix form of organization, see Figure 5 in Chapter VII.

> is crippled. It is for this reason that we are set up as we are -- with basic research separated organizationally, but not geographically, from applied and product research.*

Jack Morton has pointed out that Bell Laboratories has a similar organizational barrier between fundamental research, on one hand, and applied research and engineering, on the other:

> . . . we want some feedback, so let us see how we get it from, say, applied to basic (research): We get it in one way with a space bond -- people in applied and basic live in the same building. And we get it through a common language. But at the same time, we see that if applied people or engineering people can dictate what the research people do, they will kill the long range basic research. So we need an organizational barrier: One man -- Bill Baker -- is head of all basic research; other men head up applied research and engineering. Our people are free to sell, to stimulate and motivate all they like. But my engineers, for example, cannot tell the basic researchers what to do. And conversely, the basic researcher who believes he has made an important discovery cannot order the applied research or engineering people to pursue it. So this organizational barrier provides freedom for basic research and freedom regarding what shall be developed.†

Our national survey of scientists provides data on the organizational characteristics and on the productivity and attitudes of research scientists in organizations that separate fundamental research activities from engineering development in comparison to those that do not.‡ These data indicate that the majority of scientists in industry and the federal government are generally employed in contexts in which research and development are combined in the same organizational unit. In the electronics industry and in nonmanufacturing companies, however, scientists are more

---

* See Goldman, op. cit., p. 44.

† See J. A. Morton, "From Research to Technology," International Science and Technology, (May 1964), pp. 88-90.

‡ These data are reported in detail in Vollmer, Adaptations of Scientists and Organizations, Chapter V, "Institutional Variations in Adaptation."

likely to be employed in contexts in which research is organizationally separated from development. Equal proportions of scientists in private companies in atomic energy activities are employed in each type of context, as is true essentially of scientists in nonprofit corporations (the majority of whom are in the "national laboratories" operated under AEC contracts). As expected, most university scientists work in contexts separated from development activities because development is not a major function in their employing organizations.

Further data from the national survey shows the characteristics of scientists in organizations in which research is separated from development in contrast to those in which the two activities are combined. These data suggest that those organizations in which research is separated from development are more likely to: employ scientists in fundamental or basic research activities (oriented primarily toward contributions to scientific knowledge), allow these scientists a large degree of freedom in selecting their own research assignments, employ them in single discipline or one-man research activities rather than in multidisciplinary teams, employ scientists with doctor's degrees, and pay them higher salaries.

Further analysis has been undertaken on what employing organizations apparently obtain as a result of the above combination of organizational environment and personnel characteristics. In those contexts where research is organizationally separated from development, as might be expected, scientists are likely to make more contributions to knowledge in their scientific fields, judging from the numbers of professional journal publications produced, and to make more notable contributions, judging from the frequency with which they indicate that their work has been subsequently cited by scientific colleagues in other organizations.

At the same time, there is little, if any, difference in the two kinds of contexts with regard to the degree to which scientists develop a sense of obligation toward, or commitment to, the goals of their employing organization, although those in the context in which research is separated from development are more likely to feel that management has given their work "the recognition it deserves" and to say that they are "satisfied with their jobs in general."

Finally, as would be expected, scientists employed in contexts where research is organizationally separated from development are less likely to have job-related contacts with nonresearch personnel in product development, manufacturing, marketing, and other organizational functions and are consequently less likely to be able to participate directly in helping to translate their research findings into useful applications within their employing organizations. There is a greater need in these

organizationally distinct units, therefore, for the assistance of research managers acting as "coupling personnel," liaison engineers, and other personnel who assume a particular responsibility for translating research findings into useful applications as a major part of their job. Other data show that research managers play an important role in "coupling" research and nonresearch activities in such situations. While only 18 percent of the scientists (nonsupervisory) in contexts in which research is organizationally separate from development reported that they have job-related contacts at least "several times monthly" with people in their corporations who are responsible for product development, manufacturing, etc., further analysis also reveals that 68 percent of the research managers surveyed in these same contexts have job contacts with nonresearch personnel at least "several times monthly." In other words, research managers are almost four times as likely to have such contacts as are nonsupervisory scientists. Thirty-nine percent of these managers reported that they had such contacts at least "several times weekly," and 20 percent said "daily."

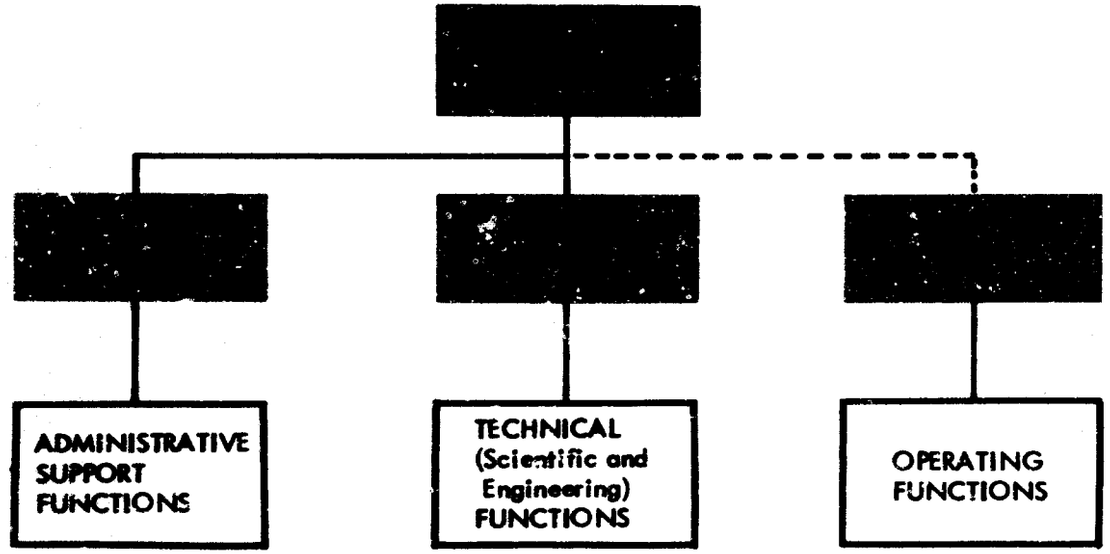
In higher level positions, research managers are likely to be performing a management generalist role. The role of the management generalist (sometimes called "general manager") is primarily an integrating role. The role of technical managers under their general direction is primarily oriented toward achieving technical quality as well as meeting administrative requirements (with regard to time, cost, etc.) through the planning and control of research and development projects, and the role of administrative managers is primarily oriented toward providing necessary support services. The role of management generalists is primarily oriented toward integrating administrative support services with technological project activities, and both with the overall mission or goal of the sponsoring organization or corporation.* This role and its relations to other management roles are shown schematically in Figure 3. The role entails the making of key management decisions regarding (1) the administrative effectiveness and efficiency of projects or programs (e.g., in terms of meeting schedule, cost, and performance requirements); (2) the allocation of manpower, time, money, and facilities resources to be made to ongoing projects; and (3) the initiation of new projects or programs.

---

* This is similar to the "linking pin function" in supervision described by R. Likert in New Patterns of Management (New York: McGraw-Hill 1961), but places emphasis especially upon horizontal (rather than vertical) coordination and integration in organizational structures.

Figure 3

THE ROLE OF THE MANAGEMENT GENERALIST



SOURCE: Author.

It is evident that the management generalist role is more likely to be performed by individuals who are in at least second level or higher management positions in a technology management organization; first level supervisors are more likely to be acting as technical managers. It is also evident that the management generalist role requires individuals with somewhat different characteristics and abilities than are required of technical managers. Whereas technical managers must be primarily outstanding in their technical abilities with regard to the type of project being managed, management generalists at higher levels must combine at least basic familiarity with the technical areas under their general management with basic understanding of administrative matters in their employing organization.*

Moreover, there is no clear career continuity between first level supervisors (mostly technical managers) and higher level supervisors (mostly management generalists).† Many technical professionals aspire to a technical manager role where they believe that they can have a maximum amount of freedom in exercising their technical abilities and making decisions regarding technical matters. They are often not interested in advancing to a higher level management generalist position, where they must, of necessity, become more concerned with general management and leadership responsibilities and less involved in purely technical matters. Thus, data from our national survey indicate that 71 percent of all the scientists surveyed who are now in nonsupervisory positions

---

* A conclusion of an Air Force content analysis study of 825 R&D management jobs occupied by officers in the Air Force Systems Command is: "Since R&D management officers are primarily managers and not scientists or engineers, they must have thorough knowledge and understanding of research and development policies, procedures, and management practices. The specialized training in management needed suggests the advisability of graduate work in management or business administration." J. E. Marsh, M. J. Giorgia, and J. M. Madden, A Job Analysis of a Complex Utilization Field: The R&D Management Officer (Lackland AFB, Texas: Personnel Research Laboratory, 1965).

† The lack of career continuity between lower level and higher level managerial responsibilities can also be identified in modern military organizations. Thus Morris Janowitz has written: "The organizational dilemmas linked to career development form a basic theme of military life. The dominant role conflict is the conflict between tactical combat skills and the requirements of higher command. Often this is stated as the clash between staff and command. But a close examination of the military establishment seems to indicate that the dilemma

say they desire to remain in nonsupervisory positions for at least the next ten years, and only 18 percent desire to move into supervisory responsibilities.* Engineers are more prone than scientists to desire a career in management, but a national survey conducted by the Professional Engineers Conference Board for Industry indicates that only about 50 percent of the engineers are positively oriented toward a career in general management.†

Although conclusive data are lacking, we can only speculate at this point about the degree to which the lack of explicit recognition of the existence and importance of such "coupling roles" and recognition of the degree to which such roles differ from other managerial roles--due to adherence to an older concept of unity of command rather than diversity in specialized managerial functions and a failure to appreciate the need for both "bonds" and "barriers" in organizational structures--prevents many organizations from achieving their maximum innovative potential. Here, the tentative proposition may be advanced that those organizational structures that (1) provide simultaneously for separated activities that handle (a) more programmed or standardized tasks and (b) more nonstandardized or unique tasks and that (2) provide effective coupling roles to assure a cross-flow of relevant information between these different kinds of activities, will be more conducive for both initiating and adopting innovations.

---

is between differing leadership skills. The skill of organizing and directly controlling small tactical units where the demonstration of technical skill is paramount gives way to the skill of organizing larger and more complex units where the elements of stress are more indirect and subtle. The military is no different from other institutions, in that the higher the position the less important specific technical skills are, and the more important are general interpersonal skills." M. Janowitz, Sociology and the Military Establishment (New York: Russell Sage Foundation, 1959), p. 59.

* See Vollmer, Work Activities and Attitudes of Scientists and Research Managers: Data from a National Survey, pp. 32-33.

† See Professional Engineers Conference Board for Industry, Career Satisfactions of Professional Engineers in Industry (Washington, D.C.: PECBI, 1962), p. 16.

Regulatory Factors

Every organization is not only a structure of people related to each other through roles oriented about the performance of specified tasks, but also a structure of written (sometimes) and unwritten (more often) rules that govern the ways in which tasks are to be performed and the ways that people are to relate to each other and to the organization. These rules not only prescribe what individuals in particular roles are expected to do for the organization, but the reciprocal obligations of the organization to the individual--both in terms of required participation in organizational affairs and in terms of prohibited interference in nonorganizational activities and concerns of the individual. An individual only gives part of himself to any organization; this part falls under the commonly recognized legitimate scope of authority of the organization. Everything outside this legitimate scope of authority is protected from managerial control.*

The system of slavery, on one hand, represents one extreme type of employment relationship in which an employee retains almost no area of individual discretion in his "life space"; he is almost completely subject to the authority of his employer-master. Such does not exist in most modern societies, however. Even conditions of involuntary servitude in military forces are generally proscribed by uniform rules of military justice, and rights against arbitrary treatment of inmates in prisons and other "total institutions" like mental hospitals are becoming increasingly recognized.

In contrast, the employment relationship for members of highly professionalized occupations represents almost the other extreme of individual discretion in the way work is performed. Professional people are bound by professional codes of ethics in the conduct of their work, but are typically subjected to a minimal amount of direction from representatives of an employing organization (i.e., supervisors). Physicians and attorneys are being increasingly employed in salaried positions, but they are commonly given a very large degree of freedom in the way that they carry out their work in these positions--even as they would be if they were serving clients as "independent professionals."† Our national survey

---

* See H. M. Vollmer, Employee Rights and the Employment Relationship (Berkeley and Los Angeles: University of California Press, 1960), especially Chapter VI "The Management of Deviance."

† See Vollmer and Mills, op. cit., especially Chapter 8, "Professionals and Complex Organizations."

of scientists found that 94 percent of the scientists on university staffs report that they have "a large degree of freedom in day-to-day research activities," and that the proportion giving this response is still quite high for those in nonprofit research laboratories, federal government laboratories, and even in private industrial companies (87, 86, and 65 percent, respectively). When asked about a variety of "possible causes for dismissal," only 12, 20, 26, and 37 percent of the managers of university, federal government, independent nonprofit, and industrial scientists, respectively, said that "refusal to undertake a research project assigned by a supervisor" would be considered just cause for dismissal. Probably the well known (and sometimes debated) fact that members of certain other groups striving for professional status (e.g., public school teachers, nurses, clergymen in certain denominations) are not generally accorded this kind of freedom by their employing organizations and by the general public is indicative of serious barriers to professionalization among these groups.

Several studies have suggested that (1) more highly professionalized groups are more likely to be both originators of innovation and adopters of innovation than less professionalized people (although granting that "overprofessionalization" may inhibit innovation),* and that (2) among professional groups, those who have more discretion in the conduct of their work are likely to be more innovative in their work than those with less discretion (although this does not deny the fact that innovative professionals may be subject to several sources of influence outside themselves, as was mentioned earlier.†

This brings us to consideration of the degree to which the written and/or unwritten rules of employing organizations recognize (1) the "job rights" that are commonly expected aspects of professional status and (2) considerations of "due process" in dealing with innovative departures from expected patterns of role performance--in other words, juridical procedures to protect the "right to dissent."‡

---

* See Wilson, op. cit.; Shapero, op. cit.

† See Vollmer, Adaptations of Scientists and Organizations, Chapter VII; L. Meltzer, "Scientific Productivity in Organizational Settings," Journal of Social Issues, vol. 12, (1956), pp. 32-40.

‡ See W. M. Evan, "Organization Man and Due Process of Law," American Sociological Review, vol. 26 (1961), pp. 540-547; P. Selznick and H. M. Vollmer, "Rule of Law in Industry: Seniority Rights," Industrial Relations, vol. 1 (1962), pp. 97-116; also O. W. Phelps, Discipline and Discharge in the Unionized Firm (Berkeley and Los Angeles: University of California Press, 1959).

Although it was pointed out earlier that the unwritten policies of most industrial companies would not condone the dismissal of a scientist for refusing to undertake a research project assigned by a supervisor, data from the national survey of scientists also show that most research managers (58 percent) in industrial companies would consider it just and proper to dismiss a scientist for "giving research ideas to outsiders without clearance from own management." (This is in contrast to 6, 10, and 18 percent of the research managers in universities, nonprofit laboratories, and government agencies who gave this same response.) In industry, it is a common doctrine that the employing organization owns the product of the scientist's labors--i.e., research ideas. However, this contradicts a professional and scientific principle of the free exchange of professional communications (a "professional right").* We have no evidence to indicate the degree to which this conflict between what is commonly asserted to be an employer right and what is commonly asserted to be a professional right may affect the motivation either to conceive innovative ideas or to put them into practice, but it is reasonable to expect some inhibitive consequences.

Furthermore, it may be noted that, unlike many production organizations (especially those that are unionized), few research organizations have yet developed any formalized procedures for juridical review of grievances of technical professional personnel. The development of formal labor arbitration procedures as aspects of most collective labor agreements,† the simultaneous growth of the role of personnel and labor relations offices in the processing of employee grievances,‡ and the increasing attention to institutions like that of the "corporate ombudsman" abroad may foreshadow changes in this direction for more professionalized employees in the United States.

In regard to the latter, Isidore Silver has written:

> ...corporate justice, especially to the company's nonunion employees...is incomplete unless some mechanism to review management decisions is established by top management itself. The function of such a mechanism would be to assure an impartial outlet for an employee's dissatisfaction with

---

* For a discussion of the importance of freely exchanging "gifts" of information among scientists, see Hagstrom, op. cit.

† Phelps, op. cit.

‡ Vollmer and McGillivray, op. cit., pp. 20-34.

> decisions adverse to him. If the corporation is to provide fair and equal treatment to employees, it should ideally combine the virtue of fair-mindedness with the necessities of thrift and efficiency. Such an impartial grievance outlet exists in the political world and, I would argue, could be readily adapted to the corporate realm. It is the institution of the ombudsman.*

Silver points out that ombudsmen in Sweden (where the system started in 1809) Denmark, Norway, Finland, and New Zealand are individuals who are learned in legal processes and who are given carefully specified and limited authority by legislative bodies to inquire into complaints against administrative officials and to make periodic reports about their findings. Experience with this institution has indicated that it operates to support and legitimatize administrative decisions, while giving individual citizens a satisfactory channel to air their grievances. But in most cases, these grievances are satisfactorily handled without having to question administrative actions directly. For example, the Danish ombudsman finds it necessary to make a formal investigation of only 15 percent of the complaints submitted to him, and only 5 percent of the complaints have resulted in statements by the ombudsman that censure administrators.†

We suspect--but we do not really know without further research--that the institutionalization of effective channels for appeal in corporate environments would encourage innovation within these environments. Specifically, we might suggest the proposition that those employing organizations that (1) fully recognize the "professional rights" of personnel in categories and that (2) provide effective independent procedures to adjudicate disagreements and grievances among professional and nonprofessional employees alike will be more conducive for both initiating and adopting innovations. The development of specialized "manpower utilization and development functions," mentioned in Chapter III, is not quite what is being suggested here, but they certainly could serve as a step

---

* I. Silver, "The Corporate Ombudsman," Harvard Business Review, vol. 45 (May/June 1967), pp. 77-87. See also W. Gellhorn, Ombudsman and Others (Cambridge, Mass.: Harvard University Press, 1966).

† Silver, op. cit., p. 78, The function of "inspector generals" in military organizations is, in theory, similar to that of the ombudsman. However, in practice it appears that inspector generals have sometimes functioned more as management informants than as effective channels for the correction of grievances.

in this direction--i.e., initially providing separate organizational mechanisms for employee utilization and eventually providing other organizational mechanisms to protect the rights of employees to be innovative in directions that they might not otherwise dare to explore.

Function and Structure

An increasing amount of organizational theory is being formulated and described from a "systems viewpoint."* This point of view emphasizes what an organization does, the technology an organization uses to process various kinds of materials, how inputs are transformed into outputs through various organizational processes, who makes significant decisions in these processes, what kinds of information are needed by these decision makers, etc. In the systems viewpoint, the formal structure of administrative authority in the organization is one of the important aspects of the organization, but not necessarily the most important. Administrative arrangements must be related to other systems processing considerations. In short, organizational structure is determined by function, rather than vice versa.

Perrow's analysis of dimensions of organization, mentioned earlier (see Figure 1) takes this functional perspective. However, this perspective is not often taken by management in designing new organizations or in attempting to redesign or significantly modify existing organizations. An organization chart, showing ho reports to whom in an administrative hierarchy, is usually among the first products of organizational design. What is unfortunate is that designers often expect the chart to determine how individuals will behave in specified roles within the organizational system. In actuality, organization charts often tell little about how people behave in organizations; an analysis of what people do in various roles and of who makes the significant decisions (i.e., the "leadership decisions" that determine the goals of the total organization)† is often much more useful.

An example of these principles was found by the author in prior studies of a variety of research organizations. The board of directors

---

* See for example, C. J. Haberstroh, "Organization Design and Systems Analysis," in March, op. cit.

† For an extensive discussion of the role of leadership in defining organizational goals and organizational character, see Selznick, Leadership in Administration.

of one research organization periodically puts out policy statements directing members of the organization to reorient their efforts toward a different kind of research than they are now conducting. These policy directives are implemented by changes in administrative structure in the organization, as are shown on revised organization charts.

However, for a period of some years these policy changes have not been implemented by the staff members in the organization because the administrative structural changes that have accompanied the policy changes have been largely ineffective. These administrative changes have no appreciable effect on two of the most significant kinds of decisions in this organization--decisions on what research projects to undertake and on new hires to the professional staff. These are decided largely by first level managers in consultation with senior staff members in decentralized research program groups. Changes in general administrative structure (who reports to whom on administrative matters) are almost irrelevant to these two kinds of significant decisions made at the working level in this organization. Until the board of directors finds out how to influence these kinds of decision, the board will never be able to achieve the policy changes that it desires.

It might be pointed out also that a substantial number of innovative ideas have come from the decentralized research program structure of this organization, but conversely, many innovative policies and program concepts have remained unimplemented in the organization itself, largely because of the hurdles that such concepts have had to overcome in this kind of decentralized organization where major functions are disconnected from centralized authority.

Function and Facilities

What people actually do in organizations, what they can do, and what they are likely to do is also related to the layout of their facilities. Thus facilities design and organizational design should be interrelated activities. This is a principle that has long been recognized in military man-machine systems design, but is only recently coming to be recognized in the design of organizational entities of the type discussed in this report.

For example, there is evidence that the spatial arrangement of facilities affects the patterns of communication, required insulation, and general productivity of research personnel. The comments of Jack Morton, cited previously in this chapter, indicate the importance of "space bonds" (i.e., spatial proximity) along with organizational insulation between

research and engineering functions in the Bell Laboratories. Further studies by Wesley Tennant and his associates at Stanford Research Institute have been almost unique in developing methods to measure the ways in which researchers actually use physical space and the appurtenances that occupy this space.* In a report on this topic, Tennant has pointed out that more than $750 million are spent annually in the United States for building or remodeling research facilities, but that:

> Only a few laboratories are reported to have been designed from criteria that incorporated the results of serious study of the current and probable future working needs of the researchers. Even in the comparatively limited area of basic environmental factors--lighting, heating, ventilation, and acoustics--the approach frequently taken has been one of piecemeal incorporation of current practice rather than an ordered assembly and application of existing knowledge in relation to the total building design.†

Moreover, in reviewing the existing literature on research facilities design, Tennant states that:

> Most of the existing literature is based on the subjective, intuitive judgment of research managers or architects, and on certain analytical, a priori viewpoints such as saving of steps, saving of time, and ease of access...Some of these industrial engineering concepts are still definitely useful in certain limited aspects of research facility design. However, our own and other groups' recent research on problems of organizing and managing technical intellectual resources indicates that it is not such things as the saving of motion and the integration of work flow that become critical in research facilities design -- but rather, it is the man-centered, project-changing, idea, information, and special equipment-oriented nature of research that is vital to facilities design.‡

---

* W. L. Tennant, "Developing Design Criteria for Research Facilities," in National Conference on the Administration of Research, Twentieth National Conference on the Administration of Research (Denver, Colo.: University of Denver, Denver Research Institute, 1967), pp. 59-66.

† Ibid., p. 59.

‡ Ibid., p. 60.

To Tennant, examples of the latter kind of crucial design variable include communications patterns (who talks to whom) and work relationship patterns (who works with whom) between various disciplines and work specialties. His study, like Morton's previous observations, found that it is necessary to design facilities and organizational arrangements to encourage useful communications, but at the same time to provide for necessary insulation:

> ...research buildings should be designed to encourage both informal and formal communications; building configuration and the location of primary and secondary rooms should encourage happenstance meetings of staff members as well as to provide many convenient spaces for planned meetings of small groups, i.e., three to seven people....
>
> Thought on how to temporarily and efficiently "turn off" offices would also be profitable...on occasion the need for privacy is as great as the need to communicate--and there are times when the best work requires uninterrupted privacy. Currently, most researchers have no way of achieving this: the phone, the door, and the walls are all channels of interruption.*

Thus, facilities design and organizational design activities can become complementary activities oriented toward creating a total environment that fosters innovative work.

The Innovation Function

The organizational and physical structure of entire organizations may be designed to provide an optimal balance between needs for communication and needs for insulation, but there may still be a need for specialized units within the organization to be concerned more especially with innovative matters--to be oriented toward investigating future possibilities for new directions in corporate efforts, rather than being oriented toward the solution of current problems. This is a major function that can be provided by fundamental research organizations within

---

* Ibid., pp. 64-65.

larger technologically oriented corporations.* In other ways, the function can also be provided by long range planning groups, technological forecasting units, etc. Moreover, the fact that these various kinds of activities are so closely related in function also argues for a close organizational relationship.

Thus, the case for separate organizational functions to foster innovative future-oriented activities is similar to the case for separate manpower utilization and development functions that was made in Chapter III. Where such separate functions do not exist within the structure of organizational entities--as is too often the case--the activities named tend to be neglected or even lacking entirely.

In sum, therefore, this and the previous three chapters have provided examples of the ways in which modern organizations fairly often fail to provide the general balance of security and challenge that individual participants need to develop their human capabilities more fully and simultaneously to contribute to organizational goals and requirements; more specifically, the degree to which modern organizations consume or waste talent; and finally, the extent to which the administrative, regulatory, and physical structure of organizations is not responsive to innovative considerations. In Part Two, we analyze the process of organizational design for the purpose of exploring the ways in which organizational design efforts might begin to remedy these kinds of problems.

---

* For a detailed discussion of this function, see Vollmer, The Fundamental Research Activity in a Technology-dependent Organization.

PART TWO: ORGANIZATIONAL DESIGN SOLUTIONS

Chapter VII

THE ORGANIZATIONAL DESIGN PROCESS

The process of organizational design may be viewed in systems terms. Design activities themselves do not stand alone, but draw on knowledge and skill from certain relevant theoretical and applied disciplines. Design efforts are oriented toward goals that reflect client interests, but these activities must also be adapted to human, economic, political-legal, sociocultural, and technological environmental constraints. The significant outputs or products of organizational design activities include goal statements, systems diagrams, organization charts, position descriptions, and even facilities designs. However, the design process should not be considered to be completed with the production of these items. Attention must then be devoted to the implementation of designs, the evaluation of their effectiveness, and the feedback of corrective information into the general fund of knowledge to improve future design efforts.

The main interrelations of these elements are shown schematically in Figure 4. Each major class of elements is discussed in the following sections, before we discuss an overall evaluation of the state of the art.

Inputs to Organizational Design

Although there are currently signs that a new applied discipline of organizational design may develop and receive general recognition in the future,* such has not developed to any significant extent to date. Organizational design and redesign activities are carried out mainly by the line managers of organizations, but with increasing help from inside staff assistants and outside consultants who, in turn, are increasingly drawing on relevant knowledge and skills from certain theoretical and applied disciplines. Furthermore, there is a tendency for line management to become more "professionalized" in all its activities.† One aspect of the

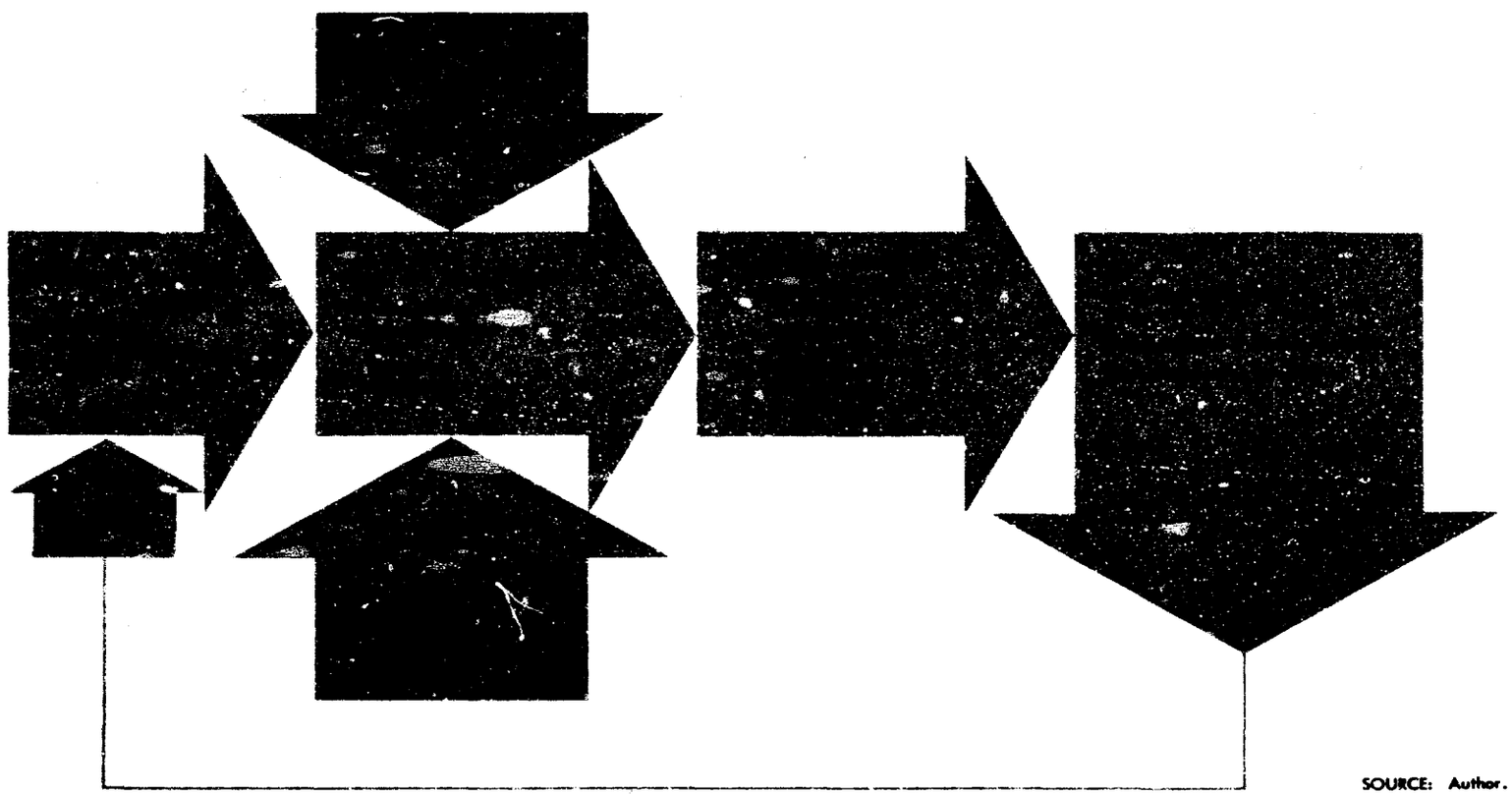
---

* See, for example, the recent writings on the topic of organizational design and specific graduate educational programs oriented toward this topic at such institutions as the University of California at Los Angeles.

† See discussions of the professionalization of business management by R. M. MacIver, T. Parsons, and N. S. Timasheff in Vollmer and Mills, op. cit., pp. 49-62.

Figure 4

MODEL OF THE ORGANIZATIONAL DESIGN PROCESS



SOURCE: Author.

professionalization of management is to receive graduate-level university training in a variety of relevant disciplines.

The major theoretical disciplines (those oriented toward the building of fundamental knowledge) that have made, or could be expected to make, significant contributions to the field of organizational design include:

Sociology
Psychology
Anthropology
Political science
Economics
Mathematics
Philosophy
History

Sociology, psychology, and anthropology are generally referred to as the basic behavioral sciences (oriented toward the study of human behavior in it's individual social, and cultural aspects). Organizational sociology, originating with Weber, Durkheim, and Pareto in Europe and with Park, Cooley, Burgess, and others in America, has made outstanding contributions to the understanding of social variables in corporate, community, and societal structures.* More recent names include Parsons, Merton, Selznick, March, Gouldner, Bendix, Homans, J. D. Thompson, Dubin, Blau, Scott, Etzioni, Perrow, and others.† In the earlier decades of the

---

* See Weber, The Theory of Social and Economic Organization; Weber, From Max Weber: Essays in Sociology; E. Durkheim, The Division of Labor in Society (Glencoe, Ill.: Free Press, 1933); V. Pareto, The Mind and Society (New York: Harcourt Brace, 1935); R. E. Park and E. W. Burgess, Introduction to the Science of Sociology (Chicago: University of Chicago Press, 1924); C. H. Cooley, Social Organization (New York: Charles Scribners, 1929).

† See T. Parsons, The Social System (Glencoe, Ill.: Free Press, 1951); R. K. Merton, Social Theory and Social Structure (Glencoe, Ill.: Free Press, 1949); Selznick, Leadership in Administration; March, op. cit., Gouldner, op. cit., R. Bendix, Work and Authority in Industry (New York: Wiley, 1956); G. Homans, The Human Group (New York: Harcourt Brace, 1950); J. D. Thompson, ed., Comparative Studies in Administration (Pittsburgh, Pa.: University of Pittsburgh Press, 1959); R. Dubin, ed., Human Relations in Administration (Englewood Cliffs, N.J.: Prentice Hall, 1961); P. M. Blau and W. R. Scott, Formal Organizations (San Francisco: Chandler, 1962); A. Etzioni, ed., Complex Organizations: a Sociological Reader (New York: Holt, Rinehart & Winston, 1964); A. Etzioni, A Comparative Analysis of Complex Organizations (New York: Free Press, 1961); Perrow, "A Framework for the Comparative Analysis of Organizations."

20th century, psychologists became interested in the interaction of individual behavior and personality with group and organizational influences, the ways in which styles of leadership influence individuals in groups, and how group performance might be measured. Notable among more recent contributions are those of Argyris, Haire, Herzberg, Katz and Kahn, Leavitt, Likert, McGregor, Schein, Tannenbaum and Vroom, as well as the earlier work of Lewin.* The community studies of anthropologists around the world have brought the attention of organizational designers to cultural factors (values, ideologies, etc.) that vary in different circumstances and to the structural-functional method of analysis of social organization, beginning with the works of Malinowski, Radcliff-Brown, and Mayo, and extending to the more recent work of Levi-Strauss and W. F. Whyte, as well as Sofer and Jacques.†

In recent years, the "behavioral approach" has also influenced political scientists and economists who are interested in the analysis of governmental and industrial organizations. As might be expected, the political scientists tend to focus on problems connected with the distribution of power and authority in organizational environments, and the economists are more likely to analyze processes of production, consumption, and economic exchange within and between organizational entities.

---

* See C. Argyris, Personality and Organization (New York: Harpers, 1957); M. Haire, ed., Modern Organization Theory (New York: Wiley, 1959); M. Haire, Psychology in Management (New York: McGraw-Hill, 1956); F. Herzberg, et al, The Motivation to Work (New York: Wiley, 1959); D. Katz and R. L. Kahn, The Social Psychology of Organizations (New York: Wiley, 1966); H. J. Leavitt, Managerial Psychology (Chicago: University of Chicago Press, 1958); H. J. Leavitt, The Social Science of Organizations (Englewood Cliffs, N.J.: Prentice-Hall, 1963); Likert, op. cit.; D. McGregor, The Human Side of Enterprise (New York: McGraw-Hill, 1960); E. H. Schein, Organizational Psychology (Englewood Cliffs, N.J.: Prentice-Hall, 1965); R. I. Tannenbaum, et al., Leadership and Organization (New York: McGraw-Hill, 1961); V. Vroom, Work and Motivation (New York: Harper and Row, 1959); K. Lewin, Resolving Social Conflicts (New York, Harper, 1948).

† See B. Malinowski, Magic, Science, and Religion and Other Essays (Glencoe, Ill.: Free Press, 1948); A. R. Radcliff-Brown, "On the Concept of Function in Social Science," American Anthropologist, vol. 37 (1935), pp. 394-402; E. Mayo, The Social Problems of an Industrial Civilization (London: Routledge and Kegan Paul, 1949); C. Levi-Strauss, "Social Structure," in A. L. Kroeber, Anthropology Today (Chicago: University of Chicago Press, 1953); W. F. Whyte, Men at Work (Homewood, Ill.: Irwin-Dorsey, 1961); C. Sofer, The Organization from Within (London: Tavistock, 1961); E. Jacques, The Changing Culture of a Factory (London: Tavistock, 1951).

The former includes such names as H. Simon and V. Thompson; the latter is demonstrated in the diverse approaches of people like R. A. Gordon and T. A. Marschak.*

In addition to full-length book publications, writings on behavioral approaches to organization theory are regularly published in such professional journals as: Administrative Science Quarterly, Human Organization, Organizational Behavior and Human Performance, and others.

Books and articles also contain many useful reports of behaviorally oriented studies of specific kinds of organizations, such as Janowitz' studies of military organizations; Perrow's, Scheff's, and Goffman's studies of hospitals; Lipset, Trow, and Coleman's study of a trade union; Selznick's studies of a government agency program and of the Communist Party; Cressy's studies of prisons; Pelz and Andrew's studies of research organizations; Clark's studies of academic institutions; Gouldner's study of a factory; and W. F. Whyte's study of restaurants; to mention only a few.†

In addition to the behavioral disciplines mentioned above, there are increasing indications that several aspects of mathematical theory,

---

* H. A. Simon, Administrative Behavior (New York: MacMillan, 1954); V. A. Thompson, Modern Organization (New York: Knopf, 1961); R. A. Gordon, Business Leadership in the Large Corporation (Berkeley and Los Angeles: University of California Press, 1961); T. A. Marschak, "Economic Theories of Organizations," in March, op. cit., pp.423-450.

† M. Janowitz, The Professional Soldier (Glencoe, Ill.: Free Press, 1960); M. Janowitz, The New Military (New York: Russell Sage, 1964); C. Perrow, "Hospitals: Technology, Structure, and Goals," in March, op. cit., pp. 910-971; T. Scheff, Being Mentally Ill (Chicago: Aldine, 1966); E. Goffman, Asylums (Garden City, N.Y.: Asylums, 1961); Lipset, Trow, and Coleman op. cit., P. Selznick, TVA and the Grassroots (Berkeley and Los Angeles: University of California Press, 1949); P. Selznick, The Organizational Weapon (New York: McGraw-Hill, 1952); D. R. Cressey, The Prison: Studies in Institutional Organization and Change (New York: Holt, Rinehart and Winston, 1961); Pelz and Andrews, op. cit.; B. Clark, Adult Education in Transition (Berkeley and Los Angeles: University of California Press, 1956); W. F. Whyte, Human Relations in the Restaurant Industry (New York: McGraw-Hill, 1948).

including scale analysis, set theory, matrix algebra, and other forms of graphic analysis may be useful in organizational design in the future.*

Without attempting to cite specific references or individuals, it should be mentioned that the disciplines of philosophy and history can provide important inputs to organizational design activities. Certainly the design of new forms of organization should be carried out in accord with the philosopher's systematic concern with the expression of ultimate values in the way that society, or major parts of society, are organized. Philosophical questions cannot be separated from consideration of "what are we designing for?" Similarly, the historian's systematic concern with what has succeeded and what has failed in the past should permeate organizational design efforts, as well as the historian's skill in careful documentation of ongoing experience. Too often, there is no adequate "organizational memory" of past experience. Thus, successful organizational design not only draws on the knowledge of organizational behavior that has been accumulated by a variety of theoretical disciplines, but also requires the skills of the philosopher in logical reasoning, the historian in documentation, and the mathematician in symbolic manipulation, as well as the behavioral scientist in systematic observation.

Organizational design can also draw on the knowledge and skills of certain applied disciplines. These are disciplines that develop theory, but their theory is ordinarily pragmatic and formulated with a view toward direct application in the management of complex organizations. These applied disciplines include:

Business management
Industrial engineering
Systems analysis and operations research
Public administration
International relations

The theoretical formulations in business management and public administration have ranged from the "classical" analyses of Taylor, Fayol,

---

* See W. H. Starbuck, "Mathematics and Organization Theory," in March, op. cit., pp. 335-386; A. L. Stinchcombe, "On the Use of Matrix Algebra in the Analysis of Formal Organization," in Etzioni, ed., Complex Organizations: a Sociological Reader, pp. 478-484; J. C. Charlesworth, Mathematics and the Social Sciences (Philadelphia: American Academy of Political and Social Science, 1963); M. W. Riley, et al, Sociological Studies in Scale Analysis (New Brunswick, N.J.: Rutgers University Press, 1954).

Gulick, and Urwick through the behavioral formulations of Chester Barnard and Peter Drucker to the modern textbook presentations of L. A. Allen, Pfiffner and Sherwood, M. C. Branch, and others.*

The concern of earlier industrial engineers to bring "sound engineering principles to the practice of management" has now been elaborated by the introduction of systems analysis and operations research methods into a variety of organizational design considerations. Currently, there is interest in identifying "who makes decisions on what" in organizational structures, what kinds of information are necessary to make these decisions, how decisions are implemented through various communications and control networks, etc.† Systems analysts are also likely to be optimistic about the possibilities of experimenting with different organizational arrangements by means of computer simulation.‡

International relations is now coming into its own as a graduate level program in several universities. This field has caused some behavioral scientists to devote attention to analyses of factors that will reduce interorganizational conflict and promote cooperative efforts, not only between nations, but also between different kinds of organizations within nations, as may be seen by reviewing articles in the Journal of Conflict Resolution and the Journal of Peace Research.

Thus, these applied disciplines can, and do, make useful contributions to knowledge relevant to organizational design activities, as well as providing useful skills.

---

* F. W. Taylor, The Principles of Scientific Management (New York: Harper, 1942); H. Fayol, General and Industrial Management (London: Pitman, 1949); L. Gulick and L. Urwick, Papers on the Science of Administration (New York: Columbia University, Institute of Public Administration, 1937); Bernard, op. cit.; P. F. Drucker, The Practice of Management (New York: Harper, 1954); L. A. Allen, Management and Organization (New York: McGraw-Hill, 1958); J. M. Pfiffner and F. P. Sherwood, Administrative Organization (Englewood Cliffs, N.J.: Prentice-Hall, 1960); M. C. Branch, The Corporate Planning Process (New York: American Management Association, 1962).

† As an example of the earlier industrial engineering approach, see L. P. Alford, Principles of Industrial Management (New York: Ronald Press, 1940); as an example of later decision theory and systems considerations, see G. Fisk, ed., The Psychology of Management Decision (Lund, Sweden: Gleerup, 1967), also Haberstroh, op. cit., pp. 1171-1212.

‡ See K. J. Cohen and R. M. Cyert, "Similation of Organizational Behavior," in March, op. cit., pp. 305-334; B. K. Rome and S. C. Rome, "Leviathan: an Experimental Study of Large Organizations with the Aid of Computers," in Bowers, op. cit., pp. 257-311.

It should be noted that there can be significant differences in the skills that the designer provides and the knowledge that he brings to bear on his various tasks, depending on the disciplinary orientation that prevails in the designer's own background. Thus, as Warren Bennis has pointed out, the operations analyst (or specialist) is more likely to try to deal with the following strategic variables in his organizational design or organizational change efforts: inventory, allocation, queuing, sequencing, routing, replacement, competition, and search. In contrast, behavioral scientists interested in "planned change" are more likely to be concerned with: identification of appropriate mission and values, human collaboration and conflict, control and leadership, resistance to change, utilization of human resources, communication between hierarchical ranks, problems of rapid growth, and career development. Bennis comments further on this as follows:

> The divergence of problem-definition leads to the selection of different variables. OR practitioners tend to select economic or engineering variables -- most certainly variables which are quantitative and measurable and which appear to be linked directly to the profit and efficiency of the system. Not so of the planned-change practitioners. While there are vigorous attempts to measure rigorously and to conduct evaluation studies, the variables selected tend to be less amenable to statistical treatment and mathematical formulation. Upon even a superficial perusal of some of the literature on planned change and OR, the difference is evident: a significantly lower ratio of tables and mathematical formulas in the former.*

We maintain herein that successful organizational design efforts must draw on the contributions of both of these and all other relevant disciplines.

How can all of this knowledge and skill be applied in organizational design? To begin to answer this question, we turn to consideration of the core of the design process itself.

---

* See W. G. Bennis, Changing Organizations (New York: McGraw-Hill, 1966), p. 87.

† This eclectic approach differs from the completely "people-centered" approaches to organizational design and planned change of some persons associated with the National Training Laboratories. The latter approaches have much of value, but can become one-sided and doctrinaire.

The Design Process

Organizational design activities are ordinarily occasioned by a desire to accomplish a perceived objective (e.g., produce some product or service) that requires cooperative effort (i.e., an organization). This objective becomes the operational goal for the new organizational structure. (Or it may be that a significant change in operational goals is desired in a currently established structure, whereupon organizational redesign efforts are initiated.)

Not all organizational design efforts are oriented directly toward an operational goal, however. Some effort is, sooner or later, oriented toward problems of how the organizational structure is to be maintained over the time period necessary to achieve the operational goal, if this has a fixed time period attached to it. Furthermore, we know from many examples that even in organizations that have fixed-time operational goals, there is a tendency for members of the organization to attempt to perpetuate it for longer time periods to preserve the personal stake that they have developed in it, as was pointed out in Chapter III. Thus, organizational maintenance goals come to the fore in the design process, along with operational goals.

This differentiation between two major kinds of goals has consequences for the form that the organizational design takes. Staff activities (oriented more toward organizational maintenance) are soon differentiated from line activities (oriented more toward operational objectives). In fact, the ratio of administrative and staff positions to production personnel seems to increase in more complex organizations, perhaps because more complex organizations require proportionately more effort to maintain themselves than is the case for smaller ones.*

In turn, organizations must be designed to accomplish their goals within particular human, economic, political-legal, sociocultural, and technological constraints that exist in the organizational environment, as was shown in Figure 4. The human constraints that affect the design of any organization include the needs of members for security and for challenge, as was discussed in Chapters III and VI. Economic cost considerations obviously have to be brought to bear on any organizational

---

* For a summary of studies on this topic, see W. A. Rushing, "The Effects of Industry Size and Division of Labor on Administration," Administrative Science Quarterly, Vol. 12 (1967), pp. 271-295.

design, but especially in the design of profit making organizations in a competitive, private enterprise economy. Economic cost considerations also must frequently be modified to accommodate to political-legal requirements that reflect changing value patterns--for example, a concern with "affirmative action programs" to accelerate equal employment opportunities for members of minority groups. (See the discussion of this in Chapter V.) Finally, there are all the technological state-of-the-art considerations that impinge on the design of physical facilities, communications channels, transportation networks, and other important features of organizational structure.

How are these various constraints brought to bear in the design of organizations oriented toward specified operational and maintenance goals in a manner that applies the knowledge and skills of relevant disciplines? Who does what in this process?

The process ordinarily entails interaction between two individuals, or two sets of individuals, acting in certain specified roles. For convenience, we shall call these the "client role" and the "designer role."*

Ordinarily, it might be assumed that an individual client, or client group, would be primarily an owner or chief executive who would request a designer to design an organization oriented toward certain goals specified by the client. However, this is not always the case, as suggested in the schematic representation in Figure 5. In some cases a designer, acting in what might be called an "expert consultant role" may actually indicate to a client how the consultant thinks the organization ought to be oriented, based on the personal expertise of the consultant, and then leave the client to work out the details of the design and its implementation. This might occur where there is already a detailed body of information regarding the implementation of organizational designs in a well-established field of activity, such as the more or less routine design of additional schools in a large school system, of a branch plant in an existing industrial enterprise, or of additional military units in a conventional military organization. But marked changes in environmental constraints could require design innovations that would not be handled effectively by this kind of role relationship.

---

* Some authors are inclined to confuse the designer role with that of a "change agent." In the discussion here, either a designer or a client, or both, may act as change agents, depending on the extent to which either one or both participate in the implementation of organizational designs or redesigns.

Figure 5

POSSIBLE ROLES OF DESIGNERS IN THE DESIGN PROCESS

		Who determines the objectives of the design process?	
		DESIGNER	CLIENT
Who determines the specific content of the design and the methods to implement it?	CLIENT	Designer as EXPERT CONSULTANT	Designer as TECHNICIAN
	DESIGNER	Designer as ARTIST	Designer as PROFESSIONAL

SOURCE: An adaptation of categories originating in discussions with Charlton R. Price.

In circumstances requiring more novelty in the content of the design and the way in which it is implemented, the designer might more appropriately be expected to assume the role of a "professional," in which the objectives of the design are specified by the client, but the designer is given the responsibility of bringing a large amount of knowledge and skill to bear on developing the details of the design and providing guidance in their implementation. This might occur in the design of new kinds of educational institutions for students with special problems (e.g., Job Corps camps), of industrial companies that require the processing of nonstandardized materials by nonstandardized methods, or of entirely new forms of military organization for guerilla warfare activities.

The designer acting in either an "expert consultant" or a "professional" capacity would seem to be more effective than either of the two other alternatives--the designer as an "artist" or as a "technician"--because the former role patterns involve both parties, designers and clients, in a closer collaborative relationship. In the artist role, the designer acts somewhat like an architect of the Frank Lloyd Wright type, who makes essentially all the significant decisions and follows through on their implementation in accord with the designer's understanding of the needs of his client. However, unlike a physical structure, an organizational structure cannot be expected to stand by itself without the significant support of its component parts--i.e., the client and his employees. If he has not participated significantly in the design process, the client could not be expected to understand it and to accept it sufficiently to be able to make the organization "run" when the artist finally leaves--as indeed he must eventually leave to go elsewhere to design another artistic creation. As Warren Bennis has concluded from his analysis of the role of "change agents" (organizational designers):

> Acceptance ... depends on the relationship between the change-agent and the client-system: the more profound and anxiety-producing the change, the more a collaborative and closer relationship is required. In addition, we can predict that an anticipated change will be resisted to the degree that the client-system possesses little or incorrect knowledge about the change, has relatively little trust in the source of the change, and has relatively low influence in controlling the nature and direction of the change.*

---

* See Bennis, op. cit., p. 175. See also L. E. Greiner, "Patterns of Organization Change," Harvard Business Review, Vol. 43, No. 3 (May/June, 1967), pp. 119-130, who reports that "the shared approaches tend to be emphasized in the more successful organization changes."

In contrast, if the designer plays only a "technician" role--i.e., provides an organization chart, job descriptions, prespecified policy statements, etc.--the client cannot expect to benefit much from the knowledge and skill that a designer in a more significant role might be expected to bring to bear in the entire design process.

Further research is needed to ascertain the comparative effectiveness of each of the above patterns of role relationships in different kinds of organizational design situations. Also, research is needed to identify further different definitions of who the client is. Up to this point, it has been assumed that the client is the individual or group who owns or principally manages the organization being designed--in other words, the main source of power and authority in the organizational context. However, as has been pointed out previously, we know that even in the most centralized organizations, a certain amount of power and discretion is decentralized. Since this is true, it is always necessary for an organizational designer to consider that, in a very meaningful sense, the entire staff of the organization is his client. He must find a way to relate to key members of the staff, at least, and to give them some sense of significant participation in the design (or redesign) process, if he expects them to accept it and implement it.

Finally, a few words might be said about the designer himself. What kind of person should he be and what should be his background? Obviously he should have (1) a good understanding of information generated in the disciplines mentioned previously, (2) knowledge of the kinds of environmental constraints faced by the particular organization he is designing so that the knowledge and skill he brings to bear is appropriate, and (3) skill in dealing with the kinds of staff members he must relate to in the client organization to implement the design effectively. The development of these three elements in particular individuals might be expected to describe the profession of organizational designer in the future.

Outputs from Organizational Design

"Organizational designs" ordinarily do not appear in a single package. They are usually embodied in the goal statements, systems diagrams, organization charts, position descriptions, and policy manuals that are prepared by organizational designers.

Perhaps the most crucial task in the organizational design process is to describe meaningfully the overall goals of the organization, because organizational goals determine other major aspects of organizational

"character." According to Selznick and others, goal-setting and associated organizational character definition are the major "leadership" functions in organizations. Sometimes it is difficult or even impossible to change organizational goals in a significant way--e.g., from craft production to mass production--because the character of an organization has become fixed in its orientation toward a previous goal. Selznick provides the following example from the notes of a Gar Wood Industries executive about a problem of this kind:

> The first boats made by Gar Wood were high quality craft, made of the finest materials by master boat builders. Later, the company decided to mass-produce a comparatively low cost speed boat for wide distribution. It developed that the entire organization found itself unable to cope with the effort to shift commitments. Workmen and shop supervisors alike continued to be preoccupied with high cost quality craftsmanship. Members of the selling staff, too, could not shift emphasis from "snob appeal" to price appeal. The quality commitment was so strong that an entirely new division -- operating in a separate plant hundreds of miles away and therefore recruiting from a different labor market -- had to be created to do the job successfully.*

Therefore, goals must be defined realistically in accord with organizational capabilities and major environmental constraints.

Particular emphasis on goal definitions can be found in the literature on "long range planning," "corporate strategy," and "management by objectives." The scope of this interest is indicated in the component sections of a chapter on "A Practical System of Objectives" in a well-known textbook on corporate strategy:

> Problems posed by partial ignorance and uncertainty.
> The planning and the long-term horizons.
> Threshold goals for the firm.
> Conflict between proximate and long-term profitability.
> Hierarchy of the long-term objective.
> Unforeseeable contingencies.
> Internal and external flexibility.
> Noneconomic objectives and constraints.

---

* See Selznick, Leadership in Administration, pp. 53-4.

Objectives of individuals.
Overall hierarchy of objectives.
Setting of objectives as an open-ended process.*

When goal statements for organizations, or divisions within organizations, are formalized, they are often embodied in what becomes known as a "charter." Following is a partial description of the formulation of charters for divisions in the General Electric Company after it had become decentralized:

> When Mr. Cordiner became President, he sensed a need for better understanding of the total enterprise. There was a need to know clearly what were the most attractive business opportunities available that were in keeping with the particular competencies GE had or could acquire. There was a need to know more precisely who was responsible for what opportunities and how effectively each was being handled.
>
> For example, two decentralized components of the corporation might be competing with each other. They might be trying to fill a customer want with the identical product, or with different technical approaches to the same customer need. That is, you can use a motor generator set for a rectifier, you can use an ignitron tube, or you can use a semi-conductor. Now, is it good to offer all those alternatives to the customer? If so, should they all be offered by one business, or should they be offered by three competing businesses? Without charters, there may be a failure on the part of the company to be in the businesses it should be in. One or more of our 104 component businesses may have been missing opportunities.
>
> We set out to develop charters for each of our businesses in order to clarify their scope for our top management group at the corporation level, for the division managers, and for the people at the points of action.

---

* See H. I. Ansoff, Corporate Strategy (New York: McGraw-Hill, 1965), Chapter 4.

Question: "How was the charter program organized?"

Well, a task force had the objective of establishing the dimensions that should be used in describing the scope of a business. It worked at developing the principles and procedures to be used in writing a charter. It did not deal with the question of whether a particular division should have a specific business scope or not; rather, it dealt with the principles involved in describing a good business scope for a division. (In GE, we call our divisions "departments.")

Question: "How long did this take? Is the task force still engaged in its work?"

No. It went out of existence when it had drawn up the principles and procedures I spoke of.

Question: "Did the task force go into each of your 104 businesses to determine the scope of the particular business?"

No, it was concerned only with how to do the job. It did go into each business in experimenting and testing. ("Will this work?" "Is this good?" "How will our charter program have to be modified?" These were the kinds of questions the task force asked itself as it tested results.)*

The above description of charter development activities in General Electric showed a concern with adapting organizational structure to particular product lines in different divisions. In other words, organization was tailored to what is being processed in the system and how it is being processed. This implies primarily a "horizontal" concern in organizational design, starting with material, financial, ideational, and human inputs; moving through significant transformation processes; and leading to desired outputs in terms of products or services. This is essentially what has been called "the systems approach" in organizational design. It is especially useful where organizations require a continuing

---

* From an interview reported in S. Thompson, How Companies Plan (New York: American Management Association, "AMA Research Study 54," 1962), p. 96.

amount of coordination in the production of complex products, as is true in the aerospace systems industry.* Nevertheless, conceptualizing the design of an organization in terms of the flow of products, services, and associated patterns of "who initiates the action of whom" can also be useful in situations as diverse as those of the restaurant industry.†

The charting of work flow has now come to be referred to as "linear organization charts," "functional organization charts," or simply "systems diagrams"--and when combined with descriptions of administrative authority patterns, as "matrix organization charts."‡ Thus systems diagrams can become the second type of product of organizational design efforts, after goal statements or charters. These systems diagrams are sometimes combined in matrix charts with the third kind of product--the more classic forms of organizational charts showing patterns of administrative authority and a functional specialization by department,§ as is shown in a simplified version in Figure 6 for a market-oriented organization.

Major questions that occur in designing and charting authority relationships include questions about the location of different decision-making functions (i.e., centralization vs decentralization), the differentiation of functions according to the extent to which they make direct or indirect contributions to major patterns of work flow (i.e., the differentiation of staff vs line activities), and relationships

---

* See C. J. Middleton, "How to Set Up a Project Organization," Harvard Business Review, Vol. 45, No. 2 (March/April, 1967), pp. 73-82; A. R. Janger, "Anatomy of the Project Organization," Business Management Record (November 1963), pp. 12-18.

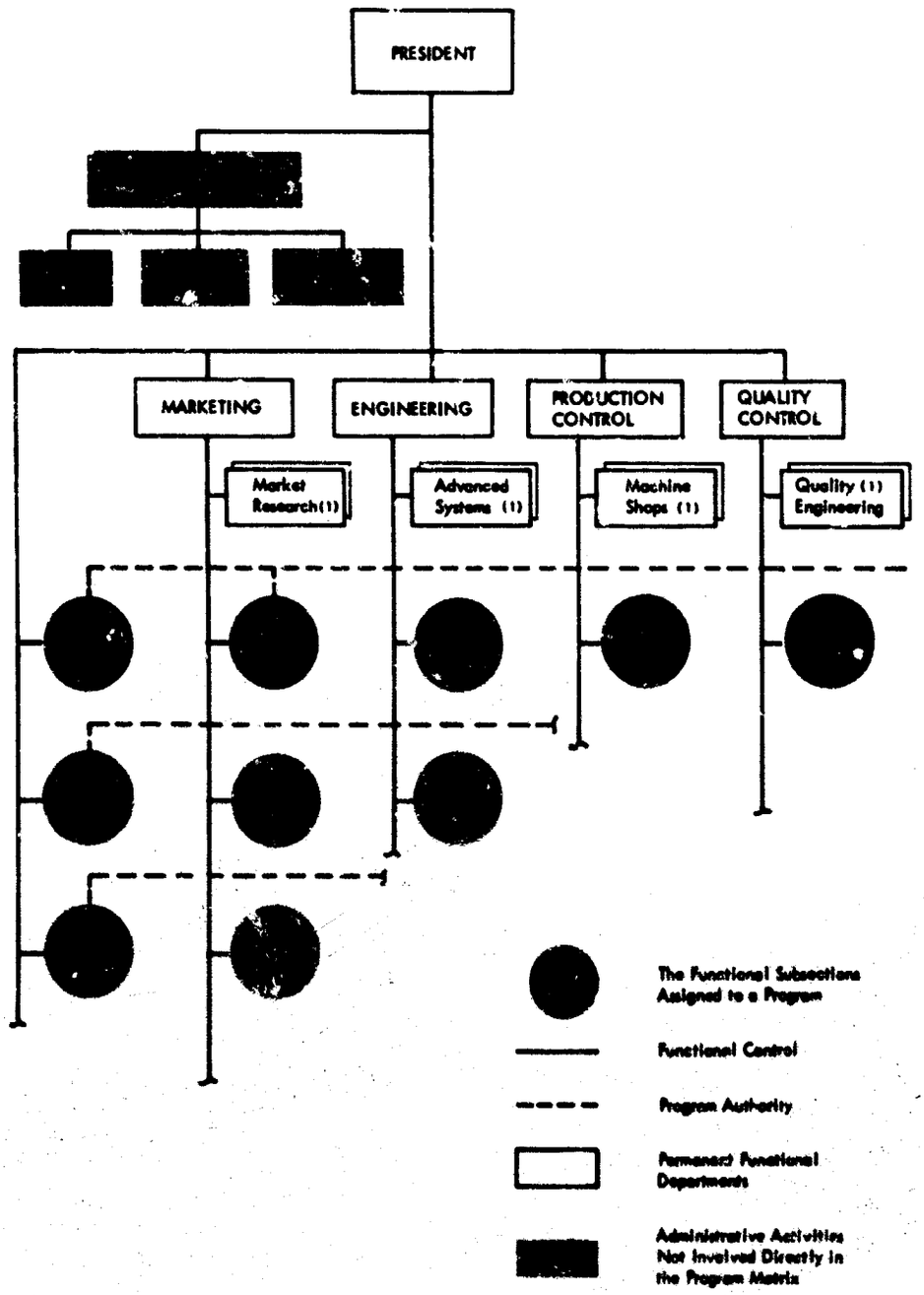
† See Whyte, Human Relations in the Restaurant Industry.

‡ For further description and examples, see A. R. Janger, "Charting Authority Relationships," The Conference Board Record, Vol. 1 (December 1964), pp. 8-13; D. I. Cleland, "Organizational Dynamics of Project Management," IEEE Transactions on Engineering Management, Vol. EM-13 (December 1966), pp. 201-205; and F. A. Shull, Matrix Structure and Project Authority for Optimizing Organizational Capacity (Carbondale, Ill.: Southern Illinois University, Business Research Bureau, 1965).

§ For a report of a survey of company practices in organizational charting, see H. Stieglitz, Corporate Organization Structures (New York: National Industrial Conference Board, "Studies in Personnel Policy No. 183," 1961).

Figure 6

A MATRIX-TYPE ORGANIZATION CHART



SOURCE: Adapted from D.I. Cleland, "Organizational Dynamics of Project Management," IEEE Transactions on Engineering Management, Vol. EM-13 (Dec. 1966), p. 204.

between similar functions at different levels in an administrative hierarchy.*

Then organization designers usually go one step further to produce position descriptions for the various types of jobs to be performed. This is a critical aspect of organization design, because it reflects the formal link between organizational requirements expressed in terms of a division of labor and the individuals who will man the organization. Position descriptions commonly include the title of the position, a description of the basic function to be performed, a description of the duties and responsibilities of the individual in carrying out this function, and a description of reporting relationships of the positions in relation to other positions.† Occasionally, position descriptions also contain a statement of the minimum educational and experience requirements for applicants.

Carefully designed position descriptions can be useful for a variety of purposes. A survey of company practices regarding managerial position descriptions reported the following uses, listed in order of frequency of mention:

To clarify relationships between jobs, avoiding overlaps and gaps in responsibility

To establish a just basis for the organization's internal salary structure (internal compensation comparison)

To help executives acquire greater understanding of their present jobs by analyzing their duties

To revise the basic organization structure and division of responsibility

---

* For analyses of these problems, see J. G. Staiger, "What Cannot be Decentralized," Management Record, Vol. 25 (1963), pp. 19-31; L. A. Allen, Organization of Staff Functions (New York: National Industrial Conference Board, "Studies in Personnel Policy No. 165," 1958); H. Stieglitz, "Staff-Staff Relationships," Management Record, Vol. 24 (1962), pp. 2-13.

† See A. R. Janger, "What's in a Position Guide," Management Record, Vol. 23 (1961), pp. 28-38; A. R. Janger, "Making Titles Meaningful," Business Management Record (August 1963), pp. 43-49.

As a foundation on which to compare jobs inside the organization with others outside it for the purpose of paying salaries in line with current rates (external salary comparison)

To evaluate individual executives' performance of their jobs.*

All of the above products of organizational design may be put together with implementing policy statements in an organization manual. A National Industrial Conference Board survey found that organizational manuals commonly contain the following somewhat overlapping types of material:

1. A statement of organizational objectives
2. Statements of policies and principles
3. Glossary of terms
4. Titles for positions and organization components
5. Organization procedures
6. Common responsibility statements
7. Organization charts
8. Position guides
9. Committee guides.†

Last but not least, organizational designers may also have a hand in the production of facilities designs, along with architects, building programmers, and other facilities design specialists. As was pointed out in Chapter VI, recognition of the need for facilities design activities to be closely articulated with organizational and work activity considerations is just beginning.‡

---

* See C. L. Bennett, Defining the Manager's Job (New York: American Management Association, 1958), p. 36.

† See L. A. Allen, Preparing the Company Organization Manual (New York: National Industrial Conference Board, "Studies in Personnel Policy, No. 157," 1957), p. 18.

‡ See Tennant, op. cit.

Implementation and Evaluation

Not all attempts to design new organizations or to change old ones are successful, however.* As indicated earlier, those that are successful are more likely to have the designer and the client jointly involved in the implementation process. An accurate analysis of the success of an organizational design also implies that a measurable criteria of organizational performance has been established.

In attempting to evaluate organizational performance, it is important to try to avoid three common errors. The first type of error may be described as the regression toward quantifiable measures. Examples of this tendency are evaluations of performance in manufacturing companies that stress quantity of units produced at low cost/sales ratios, without considering less tangible measures such as the durability of items produced and customer satisfaction; enemy kill-ratios in warfare, rather than more difficult evaluations of the extent to which war tactics are actually reducing an enemy's capacity to retaliate; the number of patients being processed through a mental hospital, rather than measures of the effectiveness of the treatment provided; and research revenue generated in a research organization, rather than the quality of the research work performed.

Another kind of error may be described as the regression toward short run payoffs. Examples include the evaluation of business effectiveness in terms of current sales, rather than in terms of long range forecasts that take into account anticipated technological and social changes; the evaluation of basic research activities on criteria comparable to those used for the evaluation of applied research activities; evaluation of military strategy in terms of its effectiveness in "winning" wars, rather than in terms of its consequences for longer term international adjustments; and evaluation of personnel policies in terms of a reduction of employee turnover, rather than in terms of career development.

The third kind of error may be described as the regression toward compartmentalized performance. In all cases, this consists of an organization's performance (or the performance of a division or department of an organization) being evaluated solely in terms of the goals or mission of the organization, rather than in terms of the requirements of

---

* Greiner, op. cit., has provided a listing of successful, partly successful, and unsuccessful efforts to change organizations.

the larger organizational, community, industry, or societal systems in which the organization performs a function. Examples of this include the evaluation of corporate performance solely in terms of profitability for stockholders, rather than in terms of the quality of goods and services provided to customers or the welfare of employees, and the evaluation of professional services primarily in terms of colleague recognition rather than in terms of client needs.

To truly advance the state of the art, the process of organizational design must not only include the development and application of performance measures that overcome the above kinds of error, but must also provide for the feedback of evaluative information into the general fund of knowledge about organizational behavior, as indicated in Figure 4. The testing of organizational designs under different environmental circumstances is necessary to advance the state of knowledge about organizations beyond the stage of empirically derived, but unvalidated speculation. Sources from which preliminary data (quantitative or qualitative) may be drawn regarding the effectiveness of organizational design efforts include:

1. Documentary outputs of the organizational design process--goal statements, systems diagrams, organization charts, position description, policy manuals, facilities designs, etc.

2. Interview comments of designers, clients, and members of the client organization.

3. Other data on productivity, profit and loss, attitude and opinion surveys, etc.

Further analysis is then necessary to determine the ways in which data drawn from these sources reflect the effectiveness of design efforts.

Organizational Design--the State of the Art

A review of the currently sparse literature that deals directly with the topic of organizational design, along with the more voluminous literature that deals with relevant aspects of organizational theory, indicates that there is no one volume that discusses satisfactorily all phases of the organizational design process. The available writings inevitably deal with one or two parts of the total process shown in Figure 4, but not with all parts of the total process that relate to the designer's interests and activities.

Thus, for example, Approaches to Organizational Design, edited by James D. Thompson, presents several essays that demonstrate useful applications of various behavioral theories to organizational design activities, but does not discuss in any detail the directions that organizational designers might go in applying these theories, possible variations in roles that they can assume vis-a-vis clients, how these behavioral inputs can modify various products (outputs) of the design process, or how their effects can be evaluated.* In contrast, essays by Herbert A. Shepard and Harold J. Leavitt in the Handbook of Organizations deal more directly with various aspects of organizational design and organizational change processes, but without systematic attention to how these processes can be linked to organizational theory and organizational research such as is presented in earlier essays in the same book.† The same may be said of the more detailed discussion of planning and controlling organizational change provided by Warren Bennis in Changing Organizations.‡ This latter work contains a particularly insightful analysis of the roles of change agents, the functions of change programs, and strategies for change, but change activities are focused primarily on organizational leadership and authority patterns instead of other aspects of organizational structure and functioning. The last essay in Handbook of Organizations by C. J. Haberstroh focuses on the design of organizations viewed more from a general systems perspective, but again gives few details about how design activities or planned changes are carried out.§

The management literature also contains some detailed analyses and descriptions of corporate planning processes, corporate strategy, planning and organizing for innovation, etc., but these more practically oriented discussions do not contain systematic linkages to the theoretical literature, so that all the relevant inputs from various background disciplines could be effectively involved in the organizational design or change process.**

---

* See Thompson, Approaches to Organizational Design.

† See Shepard, "Changing Interpersonal and Intergroup Relationships in Organizations," and H. J. Leavitt, "Applied Organizational Change in Industry: Structural, Technological, and Humanistic Approaches," in March, op. cit.

‡ Bennis, op. cit. For an earlier collection of readings, see W. G. Bennis, K. D. Benne, and R. Chin, eds., The Planning of Change (New York: Holt, Rinehart and Winston, 1961).

§ Haberstroh, op. cit., pp. 1171-1212.

** See for example, Branch, op. cit., Ansoff, op. cit., and D. A. Schon, Technology and Change (New York: Delecorte Press, 1967).

Finally, there are biographical and case study descriptions of the activities of organizational design and planned change, and even attempts to measure the effects of planned changes in organizational contexts, but these discussions deal more with design activities and their effects rather than with providing a systematic assembly of information that could be used as inputs to these activities.*

In summary, there is need for integrated literature that offers guidance to designers on all phases of the organizational design process, especially (1) linking skill and knowledge inputs from relevant theoretical and applied disciplines to the various roles that designers can play in the design process and (2) linking the various outputs of this process to strategies for implementing and evaluating the effects of organizational design efforts. This kind of literature covering the entire design process could provide a needed definition of the scope of activities concerned in the emerging profession of organizational design (and hence a guide to professional curriculum development), as well as a stimulus to the feedback of information from test and evaluation efforts into the general fund of relevant theory on which this emerging profession is based. Moreover, such an integrated literature could provide the guidance necessary for successfully overcoming some of the major weaknesses in many organizational structures today, which were pointed out in Chapters III, IV, V, and VI--namely failure to provide for the integration of both individual and organizational needs for a balance between security and challenge, for the conservation and enhancement of individual talents, and for organizational structures with strong innovative capabilities.

The present study is oriented toward these objectives.

---

* See, for example, E. Dale, The Great Organizers (New York: McGraw-Hill, 1960); and S. E. Seashore and D. G. Bowers, Changing the Structure and Functioning of an Organization: Report of a Field Experiment (Ann Arbor: Univ. of Michigan, Survey Research Center, 1963).

Chapter VIII

SOME CASES IN ORGANIZATIONAL DESIGN

Some of the ideas expressed in previous chapters may be brought together and their usefulness tested in a preliminary way by examining several cases in organizational design. These are cases in which either line managers or organizational designers together with management clients have acted to design a new organizational entity or to modify significantly an existing entity.

In examining these organizational design cases it is useful to consider the following sets of questions derived from previous discussions (although every question may not apply with equal usefulness to each case):

1. Inputs to design activities. What skill and knowledge is drawn on for the purposes of organizational design in this particular instance? What relevant skill or knowledge is neglected? How is skill or knowledge used and how effective is its use?

2. Goal formulation and implementation. How are organizational goals formulated and implemented in this particular case? Are organizational maintenance goals identified separately from operational goals and, if so, how are they related to operational goals?

3. Environment constraints. Which environmental constraints are recognized in the design process? Are there any that are unrecognized? How do the recognized constraints influence the design?

4. Role of the designer. If there is an organizational designer separate from line management in the design process, what role does the organizational designer play? How effective is this role? What factors are associated with its effectiveness or lack of effectiveness?

5. Outputs from design activities. What form do the outputs of the design process take? What is included and what is not?

6. Implementation of the design. How is the design implemented? Who has responsibility for what? How well has the design been accepted and acted on in the client organization?

7. Evaluation and feedback of results. How is the design evaluated or how could it be evaluated? Is there any feedback of results from the evaluation procedure to the general fund of knowledge about organizational behavior, so that this fund is increased and inputs to future design efforts are enhanced?

8. Total systems adequacy of the design. In the total design process, what consideration is given to individual and organizational needs for a balance between security and challenge, to the conservation and enhancement of human talents, to the support of organizational capacity to innovate, or to other significant aspects of the organization as a functioning social system? How effective are these considerations in the particular case being considered?

These questions are applied here to the design of four kinds of organizational entities: (1) fundamental research organizations within larger "mission-oriented" industrial or government structures; (2) interjurisdictional local organizations for provision of public services under conditions of severe and widespread emergency; (3) a manpower development program for a "poverty category" population group; and (4) a factory engaged in the high-speed mass production of paper products and packaging materials.

One of these organizations--the manpower development program--may be considered to be a people-processing organization. Its primary functions are the education and training of the people processed through the organization. The factory, of course, is primarily a material-processing organization, taking raw materials and turning them into finished products. Fundamental research organizations may be considered to be idea-processing organizations; it is their business to take the ideas that come either from previous research studies or from practical problems that call for research solutions and to turn these ideas into new scientific discoveries (contributions to fundamental knowledge) through the process of scientific research. Public service organizations take human skills, materials, and facilities and provide law enforcement, fire protection, water distribution, medical, and other services to the public.

In processing these human, material, ideational, or service items, these particular kinds of organization characteristically use four different kinds of technology, as indicated in Figure 7. For example, the

Figure 7

TECHNOLOGY OF THE CASE STUDY ORGANIZATIONS

		FORM OF MATERIAL PROCESSED	
		STANDARDIZED (few exceptions)	NONSTANDARDIZED (many exceptions)
METHOD OF HANDLING MATERIAL	NONSTANDARDIZED (large amount of discretion in application of rules to procedures, criteria for decisions, etc.)	CASE C: Manpower Development Program	CASE A: Fundamental Research Organizations
	STANDARDIZED (preformulated rules to determine procedures, criteria for decisions, etc.)	CASE D: Mass-production Factory	CASE B: Emergency Public Services

SOURCE: Author; see Figure 1 for the rationale underlying these categories.

ideas that fundamental research organizations (Case A) process do not come in any kind of standardized form, and the methods used in the processing are nonstandardized (i.e., call for a large amount of discretion on the part of the professional researchers who do the processing).

In turn, a manpower development program of the type discussed here (Case C) takes many individuals and family groups who are prestandardized with regard to their common culture, general level of economic poverty, lack of formal educational and work experience background, English language and general communications inabilities, and related social psychological characteristics. It then attempts to provide them with general educational and specific vocational training necessary to be able to take a job and hold it in modern American society. Although the people who enter the manpower development program may be somewhat standardized in their backgrounds, the way in which they or their families are handled in the educational programs certainly requires a great deal of individualized treatment on the part of highly skilled professional teachers, counselors, etc.

Emergency service organizations (Case B) must be designed and built according to a large number of preformulated rules of procedure, criteria for decision, etc., to conform to political, legal, social, economic, military, and other considerations, but the way in which different services are provided to the public under different kinds of emergency conditions would certainly be nonstandardized.

In contrast, most mass production factories process standardized materials according to standardized or preformulated methods. This is essentially true of Case D, although it is not as true as it would be in some factories, because many orders for production items in this factory are single-run items handled against tight delivery deadlines, thus imposing complex problems of scheduling, quality control, and machine set-up changes that are more characteristic of job shops.

Case A (fundamental research organizations) provides a retrospective picture of the design of four existing organizations with similar objectives, along with a forward-looking view of management plans with regard to future change. Cases B and C (emergency public services and the manpower development program) are examples of attempts to design currently nonexisting structures to meet special public needs. Case D essentially represents the result of efforts to redesign an existing industrial organization.

In Case A, organizational design specialists can be seen as being in a minor role (as "technicians"), if involved at all; line managers perform the role of determining the objectives of the design process as well as the specific content of the design and methods to implement it. In contrast, organizational design specialists can be viewed as playing more of a "professional" role in Cases B and D. In Case C, the designers start in a professional role, but end up as technicians.

Finally, Cases A and D can be viewed as exemplifying design efforts that have largely succeeded in achieving their goals. The design in Case B has not yet been tested. In Case C, the design effort was not favorably received by the client.

Therefore, while these four cases do not provide examples of all of the possible permutations in types of organizational design and related activities discussed or implied in previous chapters, they do provide enough variation to begin to explore the applicability of many of the principles stated earlier.

Case A: Fundamental Research Organization

This case really represents a composite picture of the design of a particular type of organization--a "fundamental research organization" within a larger "mission-oriented organization." The larger organizations and general categories from which this composite picture is drawn are the Boeing Company (aerospace industry), the Bell System (communications), the National Aeronautics and Space Administration (federal government), and the U.S. Air Force (federal government, Department of Defense). The specific organizations discussed are the Boeing Scientific Research Laboratories, the Bell Telephone Laboratories, the NASA Electronics Research Center, and the Air Force Office of Scientific Research (AFOSR). All four research organizations are oriented toward conducting or sponsoring phenomena-oriented research programs relevant to the overall objectives of the parent organizations. Mostly, the first three conduct this research in their own in-house laboratories, while AFOSR sponsors fundamental research in universities and other scientific institutions in areas pertinent to the mission of the Air Force.

The data on which this analysis is based are largely drawn from statements of line research managers made in a session on "Planning Phenomena-Oriented Research in a Mission-Oriented Organization" at the

American University Center for Technology and Administration's 12th Institute on Research Administration, held in Washington, D.C., April 24-27, 1967.* Although the purpose of this session was primarily to indicate how research managers go about planning organizations of this type, the comments provided many retrospective insights into principles and practices of the initial design of such organizations.

The following summarizes these comments under the question headings indicated earlier.

Inputs to Design Activities

There was no evidence in this planning discussion to indicate that organizational design specialists had played any major role in the design of these research organizations; they were designed by top line managers, based on their own managerial and technical expertise and their understanding of overall organizational needs. One of the speakers described this as follows:

> In an industrial corporation, top management must decide whether there is to be a corporate research laboratory, how the activity is to be supported, and at what level... So in NASA, Mr. James E. Webb and his associates made these decisions regarding the Electronics Research Laboratory. The decision to create ERC was based upon a firm conviction of need and has not been affected by current constraints. Headquarters' prime responsibility for administration was assigned to the Office of Advanced Research and Technology. Further planning and study at Headquarters established the ultimate size of ERC, its location, and its major areas of activity.

Since the role of design specialists has usually been minor in these kinds of design activities (e.g., assisting as technicians in "planning and study at headquarters"), there is often little conscious attempt to bring specific inputs from various background disciplines to bear on the

---

* The session was moderated by H. M. Vollmer, and included G. L. Hollingsworth (Boeing), and J. K. Galt (Bell Laboratories), L. C. Van Atta (NASA), W. J. Price (AFOSR), and D. Pelz (University of Michigan). The complete presentations in this session are to be included in a forthcoming book edited by R. I. Cole.

design process. On the other hand, because the top level managers who are responsible for the design are often people who have some professional training as managers (e.g., either in graduate schools of business administration or in professional management seminars such as those conducted by the American Management Association), principles from both theoretical and applied disciplines are often influential in the design of these sophisticated types of organizations. Some parent organizations, such as the Office of Aerospace Research of the Air Force (the immediate parent organization of AFOSR) have solicited inputs from time to time from several behavioral scientists and management specialists.*

Goal Formulation and Implementation

In these kinds of organization, the articulation of research organization goals with those of the parent organization is of primary importance. As one speaker put it:

> It is of primary importance that such goals (for the research organization) be set, first and in the broadest sense by statements of the (parent) organization's mission. This is a point at which the phenomena-oriented research area...makes contact with top management, for such goals must ultimately be stated at that level. The importance of such statements can be recognized by noting that the research area bears a primary responsibility for the future of the mission-oriented (parent) organization. It is clear that an indispensable tool for meeting this responsibility is an understanding on the part of the research management of the broad goals of the mission-oriented organization as a whole. It is appropriate for research management to influence such goals. But it is vital to the development of a viable strategy of research management that, whatever they are, they be understood by both management groups.

How are such goals implemented? In other words, how is assurance developed that research managers and the scientists under them will pay

---

* See Vollmer, Applications of the Behavioral Sciences to Research Management: an Initial Study in the Office of Aerospace Research.

attention to the overall goals of the parent corporation in their daily work? The four speakers tend to agree that this is achieved primarily by:

1. Identifying research fields or research program areas in terms of their relevance to corporate goals.

2. Selecting professional research personnel who already have strong research interests in these program areas.

3. Within these program areas, allowing research personnel to have a wide latitude of choice of their own research projects to maximize their motivation.

4. Providing arrangements that facilitate communication and periodic collaborative efforts between professional research personnel and personnel in the nonresearch parts of the larger organization.

There is no overt mention of organizational maintenance goals in contrast to operating goals in the presentation remarks, but one can infer concern with these matters from comments on long range planning with regard to equipment and facilities and with regard to the career development of professional personnel, as indicated in the following remarks from the American University Conference Session:

> The final consideration in planning a research project is whether you can really support it to the end. After all, if the man will need a cyclotron three steps down the road, you better be prepared to buy it, or not take those first two steps. You ought to think that far ahead, and this is not a trivial consideration.
>
> (On) form of career development is the movement of personnel out of the research organization. This movement can be either back to the university or into other parts of the mission-oriented organization...As for the movement of personnel from phenomena-oriented research into the technologically oriented parts of the organization, it is in general a good thing for careers, a way of injecting the most novel science into technological work, and a way for the organization to raise its standards in selecting people for promotion. Care in selection of personnel for such changes is required, but a sensitivity to the possibility of such changes is a way of gaining for the mission-oriented (parent) organization one of the real benefits of supporting research.

Environmental Constraints

The comments of all the conference speakers reflected management concern with three major kinds of constraints that effect the design of this kind of organization:

1. Human constraints--the kinds of research scientists that constitute the key staff in these kinds of organizations generally have intense professional commitments to doing research work on certain particular topics. They expect a large degree of freedom in selecting the specific projects which they conduct and they are usually not very flexible in the kinds of things they want to work on (as are most engineers, for example). Therefore, scientists must be selected for the staff on the basis of the correspondence between their professional research interests and the interests of the parent organization.

2. Technological constraints--in many cases, a parent organization may not be prepared to follow through on the technological development of breakthroughs or discoveries originating in the fundamental scientific laboratories of the corporation. Therefore, there is need for continuing communication between scientists in the fundamental laboratories and technologists in other parts of the organization so that (a) these technologists are better prepared to capitalize on the results of scientific discoveries when they occur and (b) scientists continue to work with at least one eye on corporation-relevant activities.

3. Economic constraints--since fundamental research activities relate most directly to long range payoffs in such matters as product diversification, development of entirely new markets, anticipation of technological and social changes that have not yet occurred, etc., rather than providing immediate support of current engineering development or operational interests, the amount of corporate financial resources allocated to fundamental research must be determined in accord with the degree to which the corporation can afford to be oriented to the long range in its total R&D efforts. In some corporations, the proportion of fundamental research efforts to the total R&D efforts have run in the neighborhood of 10 percent; this proportion tends to be larger in larger, more diversified corporations in high-technology industries, and lower in smaller, less technologically oriented companies.

Taken together, the above three major kinds of constraints have significant implications for the design of fundamental research organizations. These implications have been summarized in terms of the "bonds-and-barriers" principles of organization, as described by Goldman of Ford Motor Company and Morton of the Bell Telephone Laboratories, and quoted previously in Chapter VI--"good research must be insulated but not isolated" and "we have a space bond and an organizational barrier," etc. They also imply the desirability of a close linkage between such activities as long range planning, technological forecasting, and fundamental research.

The Role of the Designer

As indicated earlier, top management in the parent corporation has most often played the major role both in making decisions regarding the goals of a fundamental research organization and the methods to be used in implementing these goals, even though in some cases "further planning and study at headquarters established the ultimate size of (the fundamental research organization), its location, and its major areas of activity." In the latter activities, whatever organizational designers were present appear to have played mostly what was described in Chapter VII as essentially a technician role.

Outputs from Design Activities

Formalized design products, such as goal statements or "mission statements," organization charts, position descriptions, and policy manuals embody the results of these organizational design efforts, especially in the two federal government agencies represented in this discussion. To these documentary materials must be added the development of formalized, periodically updated, long range plans for these fundamental research organizations, describing future changes or modifications in research program areas. These are often based on inputs from corporate long range planning efforts, and may reflect a systems view of the relationship between the research activity and other activities in the larger corporate complex. This is indicated in Dr. William Price's remarks about AFOSR:

> Inputs appropriate for consideration in planning the AFOSR research program come to us in many ways. Let me first mention information about the long-range needs of the Air Force which comes to us from top management. The Secretary of Defense and of the Air Force, the Chief of Staff of the AF, and others, make speeches and also provide various

internal documents. "The Plan", USAF Planning Concepts, a fifteen-year projection prepared by the Deputy Chief of Staff, Plans and Operations, is one such document that is important to us. From "The Plan" we learn about the projected military tasks -- tactical and strategic warfare, space operations, etc. We carry on a dialogue with the persons responsible for preparing "The Plan", thus furthering our understanding of its implications for our research planning. At the same time we also influence "The Plan" by helping elucidate the implications of emerging scientific opportunities on future AF operational plans.

We also receive important guidance from the Air Force Systems Command (AFSC). Two principal inputs are the AFSC Planning Activity Report and the Technical Objective Document. The latter, for example, sets forth the AF interest in each of the thirty-eight technical areas.

Using these various sources of information, we have developed a list of technology areas to be considered in assessing the relevance of research. The relevance is studied with the aid of a large matrix showing the relationship of the technology list to a similarly detailed list of the scientific areas. It is very important to note that the technology list includes both the areas designated by AFSC technology organizations and those which we add as a result of other inputs. For example, our list includes activities in support of military assistance programs, personnel management and training, logistics, and other needs which we find arising from other parts of the Air Force.

These additions are very important, we feel, in carrying out the corporate research function. Our studies of science and technology interactions convince us that it is very misleading to expect a neat flow of research needs from technology, just as it is unrealistic to expect a simple flow from a scientific discovery to applied research to development, etc.

Implementation of the Design

The primary responsibilities for implementing these organizational designs rests with middle-level research managers in all of these corporate contexts. In these implementation efforts, middle-level managers

play key roles as "couplers" between the technical interests of research groups under them and the engineering development and operational concerns of the parent organization. Thus they serve essentially as "management generalists," as this role was described in Chapter VI (see Figure 3). For example, in the Bell Telephone Laboratories:

> . . . it is important for the management of the research area to communicate problems and achievements both vertically to their superiors and horizontally to the management of other parts of the mission-oriented (parent) organization. The latter function basically requires personal contact across organizational lines by management personnel.

In NASA:

> . . . the research director must further define technical areas of interest and the relative emphasis among these areas, must establish the major elements of the research organization's administrative and technical structure, and must attract competent personnel into key positions in his office or reporting directly to him. The research director must be the link between scientific and support activities, and the spokesman for the research organization with top management.

And in AFOSR:

> An AFOSR program manager typically has about twenty active contracts and a million dollar annual budget. . . It is clear that his personal knowledge of both the emerging opportunities of science and the DOD needs are highly important aspects of his qualifications. It is also very important that he develop appropriate meaningful contacts with those persons throughout the AF most interested or most likely to be interested in the research program for which he is responsible.

Evaluation and Feedback of Results

In one sense, all the studies that have been made of the effectiveness of research organizations have provided, among other things, an evaluation of the design of the kinds of research organizations described here. The publication of these studies also provides a means for feedback of the results of this evaluation into the general literature on organizations and organizational behavior. Professor Donald Pelz of

the University of Michigan reported on some studies of this kind at the American University meeting mentioned previously.* Pelz described his own findings on the most important organizational influences on scientists in these kinds of organizations in terms that were discussed in more detail in Chapter III, but were summarized at the meeting as follows:

> In a number of ways, then, we found that the best work came when scientists on the one hand had some source of security or protection, but on the other hand had some source of challenge or exposure to external demands. It was not a question of one or the other, nor of a halfway compromise between them, but of the presence of both.

This overall evaluation of the key items necessary to the successful design of fundamental research organizations in people-oriented terms is in accord with the views expressed by the four research managers on this panel. Although fundamental research organizations may be viewed primarily as "idea processing organizations," one speaker summed up the main organizational requirements for this kind of organization succinctly when he said: "In the kind of research we are discussing here, the crucial item is people."

Total Systems Adequacy of the Design

Where both "bonds" and "barriers" exist, it appears that fundamental research organizations within larger "mission-oriented organizations" are generally able to provide the combination of security and challenge that research scientists need to work most effectively, and middle-level research managers are generally able to perform a "management generalist" role in coupling research activities to the interests of the larger corporate entity with a reasonable degree of success. Because the research work done by scientists in these organizations (by the nature of the organization) is at the forefront of new knowledge in the various technical fields, technical manpower obsolescence is generally at a minimum. Moreover, the innovative capacities of the research organization and, in turn, the total corporate structure tend to be strong.

---

* See Pelz and Andrews, op. cit. See also the summary of the author's work on this topic in Adaptations of Scientists and Organizations.

On the other hand, in situations known to the author where an attempt has been made to design a fundamental research organization without sufficient insulation from the larger organization or, conversely, without sufficient coupling with the interests of the larger organization, the fundamental research effort has been less productive.* Perhaps more active use of organizational design specialists who are familiar with these kinds of organizations and who would provide a stronger role to assist managers in the design of such organizations in the future would help to avoid these kinds of error.

Case B: Emergency Public Services

Organizations to provide public services such as law enforcement, fire protection, water distribution, medical, and other service needs on a local and areawide basis in the event of a major emergency (nuclear attack, earthquake, massive fire or flood, etc.) are quite a different type of organization. Considerations in the design of these kinds of organizations are drawn mostly from a report by Kendall Moll and Richard Hirshberg, The Cost and Feasibility of Emergency Cooperation among Local Governments (Menlo Park, Calif.: a Stanford Research Institute Report to the U. S. Office of Civil Defense, 1967).

The primary problem that must be faced in the design of these kinds of organizations is that the public services mentioned are normally (in situations where a serious emergency does not exist) provided by a patchwork pattern of local governmental and quasi-governmental services with many overlapping jurisdictions. In situations of severe emergency, what is needed is some kind of coordinating organization that is most capable of continuing to provide these vital services at the local level in the face of uneven damage and social-economic-political disruption. Previous studies have found that the most effective organizational structure for this purpose would be one of "area control--compulsory cooperation directed by an area controller," rather than "mutual aid (voluntary cooperation among jurisdictions on a bilateral basis)" or "area coordination (voluntary cooperation effected with the aid of a central area coordinator)." The report mentioned above elaborates on the design of an "area control" type of emergency public service organization.

---

* See Vollmer, The Fundamental Research Activity in a Technology-Dependent Organization; see also Vollmer, Adaptations of Scientists and Organizations, Chapter V, "Institutional Variations in Adaptation."

Inputs to Design Activities

As the report indicates in its text and footnotes, this design draws significantly on (1) previous studies of emergency public service organizations, (2) behavioral sciences literature on organization and on disaster behavior, and (3) systems analysis techniques for structuring complex systems.

Goal Formulation and Implementation

The goals for this organizational structure have been essentially set by the U.S. Office of Civil Defense Federal Civil Defense Guide, Part E, Chapter 2, "Direction and Control for Civil Defense Emergency Operations." In turn, the objective of the design effort was to carry out "A further assessment of the alternative organizational configurations . . . which would investigate their sociological, political, and legal implications within the framework of state and local government and of the community at large."

Environmental Constraints

As indicated above, it was part of the main objective of this effort to explore sociological, legal, and political ramifications and constraints on the design of this kind of organization. In the sociological and political realm, the organizational designers found that even though local government officials are jealous of their autonomy in administering a variety of public services in normal times, they are willing to accept "imposed solutions" (i.e., "area control") in situations of extreme emergency, provided that (1) voluntary assistance and local government structures are used whenever possible and (2) stronger controls are provided by "a progressive series of authority steps proportional to the degree of the emegency."

From the legal standpoint, it was found that (1) for one test county in California, the local legal authority permits forms of emergency service organization that conform to the two principles stated in the previous paragraph; (2) the California Disaster Act also conforms well with this form of emergency service organization; but (3) the federal Model State Civil Defense Act might include more detail to be more closely related to local emergency service organization needs.

Role of the Designer

In this case, the designers could be viewed as serving in the role of "professionals," in that the goals of the organization to be designed have been clearly set by the client (the U.S. Office of Civil Defense). The designers had the responsibility to determine the specific content of the design and related features connected with implementation--e.g., costs of alternative levels of implementation.

Outputs from Design Activities

Major outputs from these design activities include maps of the present jurisdictions of public services within the test county, matrix analysis of interfunctional relationships of service agencies as well as more customary organization charts, and tables showing per capita costs for various alternative levels of implementation. All of these are presented within a project report providing further descriptive material and a rationale for the organizational structure designed. Such design details as job descriptions were not included as part of this project.

Implementation of the Design

Along with cost data, the project report contains detail on the feasibility of the "area control" concept of emergency public service organization, both in terms of general acceptance by public officials and the general public and of meeting legal criteria of acceptability.

Evaluation and Feedback of Results

To date there has been no actual implementation effort in this organizational case; therefore, there has been no field test of its adequacy or opportunity to feed the results back into relevant bodies of knowledge.

Total Systems Adequacy of the Design

In view of the lack of implementation effort in this case to date, one can only speculate on the total systems adequacy of the design effort. A review of the design materials does indicate, however, that the "area control" type of organization described here has been designed with an accurate understanding of the basic technological dimensions of

this form of organization (see Figure 7)--namely that in its operating phase (during an emergency situation) it must be highly adaptable to handling unforeseen circumstances, but it also must be carefully planned in structure, details of responsibility, etc., to handle these circumstances rapidly. Fundamental research organizations of the type described in the previous case, for example, might be quite adaptable to handling unforeseen circumstances, but these kinds of research organizations are not noted for being able to bring talents to bear on a new problem very quickly.

At the same time, the kind of emergency public service organization discussed here is politically very sensitive in its building phase (before an emergency occurs). It requires the close cooperation of diverse and overlapping political groups. This can only be achieved by close attention to matters of public acceptance--both attitudinal and legal.

This design study claims that the design would be feasible in terms of the latter considerations. It attempts to meet the former requirement--for quick coordinated effort on unanticipated problems--by prescribing an "area control" type of organization with a high degree of centralized authority. However, actual implementation and testing of the design would be necessary to determine whether these "paper and pencil" estimates are accurate.

Case C: Manpower Development Program

For about six months in 1965 and 1966, the author and two colleagues, William C. Pedersen and Charlton R. Price, were employed by the governing council of one of the larger Indian tribes in the western United States to design an overall manpower development program to increase the employability of tribal members, in accord with the terms of a grant for this design effort that the Tribe had received from the U.S. Office of Economic Opportunity. In initiating this effort, it was noted that there was a strong need for "improving the life circumstances of groups which are marginal and disadvantaged in modern urban-industrial society." The report stated that:

> On the North American continent, such groups include the members of racial and ethnic minorities who--because of primitive customs, lack of employment experience, low job skills among those with work experience, lack of formal education, poor physical and mental health, remote geographic locations, long-standing prejudice and discrimination in the majority community--have been ill-equipped to participate in the urban-industrial world.

As a result of this lack of preparation, about 30 percent of the male labor force in the tribe discussed here are unemployed; another 40 percent have only occasional employment; and as a result, the vast majority of family incomes are in the "poverty" category.

Inputs to Design Activities

Among the major assumptions underlying the effort to design a program to remedy these kinds of conditions among members of this particular Indian tribe were the following, based on a variety of previous economic, sociological, and anthropological studies:

1. That despite the development of some employment opportunities resulting from all currently planned and foreseeable future industrial and commercial developments in this reservation area, these opportunities would still be insufficient to meet the employment needs of a rapidly expanding reservation population.

2. That, therefore, a considerable proportion of the tribal labor force (from one-half to two-thirds in this case) would have to be prepared to take advantage of job opportunities in other areas (i.e., urban-industrial centers).

3. That the vast majority of these people are ill-prepared by past experience and education to take advantage of currently available job opportunities; in other words, they currently lack the basis for making a viable choice to seek work in an urban environment (many have already experienced failure in attempts to do this).

4. That adequate preparation for urban living requires group education and training, involving entire family units and communities, as well as individual skills training (studies have shown that previous failures to adjust to urban living among Indians are often traceable to family strains and lack of family adjustment).

5. That, as far as possible, tribal members desire to retain valued traditions, kinship ties, ceremonials, etc., in making adjustments to urban life; furthermore, that the retention of valued cultural traits where possible enriches the total quality of life in a pluralistic society, such as that of the United States.

6. That, finally, such total cultural adaptation requires adjustments on the part of employers, neighbors, and other members of the majority society, as well as members of minority groups.

Goal Formulation and Implementation

The goal for this project, as established by the client organization (the executive office of the tribal council under the terms of the OEO grant) were to design "a program and facilities to provide assessment, vocational counseling, basic education, vocational training, work experience, social counseling, and job development services" to increase the employability of tribal members to a level comparable to that of the American population as a whole. The designers were given the responsibility of specifying the interrelationships of elements in the total manpower development program; the administrative structure for the program; job requirements and manning tables; location of facilities; costs for the acquisition of facilities, their operation and maintenance, personnel salaries, and related support services; and other matters relevant to the total program design.

As major aspects of the program, the designers proposed:

1. "Intake centers," including mobile trailer units to provide recruiting, initial orientation, assessment, vocational counseling, and initial work experience for individuals and families while still living at home in five areas of the reservation.

2. "Transition community training centers" in three reservation locations initially, using abandoned mining towns, military base, and boarding school facilities, where more intensive basic education, vocational training, work experience, family management training, and community organization experience would be given to individuals and whole family units.

3. "Community centers" combined with job placement and development offices in three urban areas where facilities and services would be provided for further individual and family counseling, job placement, follow-through job development contacts with employers, housing assistance, opportunities for ceremonial and recreational gatherings, etc.

4. Assessment and guidance procedures whereby (a) individuals with different kinds of previous experience and/or education could enter this program at a point appropriate to their own background and (b) individuals could move through the different phases of the program according to their own rate of learning and could "recycle" through any phase where necessary.

5. That approximately one-half of the staff personnel who would operate this program would be tribal members--in positions requiring minimal skill or education at first, but later in all positions. It was assumed that this would have the advantages of (a) providing immediate employment for some tribal members who needed or desired this kind of employment and (b) providing role models of "success" that would help motivate other tribal members to participate as trainees in the program.*

Environmental Constraints

In the course of the design effort, however, serious environmental constraints arose that finally prevented its success. One involved the necessity for elected tribal council officials to remain in office in what turned out to be a bitterly contested local election in this reservation area. It became evident that any official who approved of a plan that would prepare tribal members "to leave the reservation," as this one partly implied, would be taking a very unpopular position in the face of the unhappy experiences that many tribal members had with previous "relocation" efforts (without the kind of preparation and support provided in this program). In the face of this kind of mounting political pressure, tribal officials constituting the client group reversed their goals for the design effort when 90 percent of the effort had been completed. They now asked for the design of a limited, reservation-oriented job development program, rather than the previously envisioned total manpower development program.

The other major constraint was the unfamiliarity of several key federal agency officials with the rationale for the concepts underlying the project. From a Washington, D. C., perspective and under diverse pressures to respond to other project needs, they applied pressures

---

* This may be viewed as an example of organizational design to increase the utilization of currently underutilized manpower, as discussed in Chapter V.

to tribal officials after the design effort was under way to reduce the levels of funding required to support this program and to confine it to on-reservation development activities.

Role of the Designer

As might be expected, the above constraints imposed severe strains on the role of the designers in this case. As in Case B, the designers saw their role as essentially that of "professionals," in which the objectives of the design process were determined by the client (in this case, tribal officials), but the specific content of the design and methods to implement it were to be worked out by the designers. However, in this design effort, several sources of confusion developed that affected the design process. One was the fact that it became unclear who the "client" really was. Although the work was being performed to meet the direct request of tribal officials, as indicated previously, it became evident during the work that the somewhat conflicting views of (1) other political elements in the tribe and (2) federal officials in Washington who were providing the funding would have to be taken into account in the design effort for it to be completely implemented.

In other words, it could be said that this design effort involved at least two covert client groups in addition to the overt client. Although the designers had requested opportunity to work more closely with these covert clients to obtain inputs for the design effort and to gain acceptance of its results, this request was not granted. The influences of these covert groups later converged to cause the goals of the design effort to be changed, when over 90 percent of the work had been completed. The manpower development program then became oriented completely toward on-reservation activities, with all reference to the off-reservation community center and job placement and development activities eliminated from the design.

Aside from the lack of time and funds to accomplish this reoriented design effort successfully, the other main problem was that, in orienting the design effort entirely to on-reservation activities, the professional judgment of the designers indicated that the reoriented manpower development program could not meet its objective--namely "to increase the employability of tribal members to a level comparable to that of the American population as a whole." Increased employability requires varied work experience, as well as proper training. As indicated earlier, analysis of the present, planned, and even vaguely possible future development of employment opportunities in the reservation area indicated that these work opportunities would not be available

to a sufficient number of tribal members in the reservation area. They would have to learn how to work in urban-industrial settings to obtain this experience. The reoriented manpower development program, eliminating all off-reservation aspects of the program, did not provide for this.

In agreeing to comply with this change of direction, the designers essentially shifted from what had been a "professional" role to a "technician" role. The client ended up specifying not only the goals of the design effort, but also significant aspects of the content of the design and the methods to be used im implementation.

At the same time, however, the client sought to impose a requirement on the designers that they assemble research data to indicate that a truncated on-reservation type program would actually meet the employment and training needs of tribal members. It was pointed out that this requirement would be impossible to fulfill, but the client was nevertheless given the design materials indicated in the following section.

As a consequence of these developments, the client accepted the materials produced in the design effort, but indicated that he was not satisfied with the supporting rationale.

Outputs from Design Activities

The outputs from the design activities included: (1) a statement of goals and a discussion of tribal needs related to these goals; (2) a systems diagram of the interrelationships between various parts of the total program and the flow of people (trainees) between these parts; (3) an organization chart showing the structure of authority and division of responsibilities at executive, managerial, professional, and technical-clerical levels of the organizational structure; (4) manning charts showing the numbers of personnel needed to fill all types of positions in the structure and the phasing to be used in hiring staff; (5) maps and descriptive materials on all facilities to be included in the program (e.g., intake centers, community training centers, program headquarters); and (6) detailed cost estimates for salaries, facilities acquisition, operation, and maintenance; and other costs connected with the initiation and first year's operation of the total program. As indicated previously, all plans and cost estimates related to off-reservation aspects of the program design were dropped at the last minute.

Implementation of the Design

To the author's knowledge, there has been no implementation of this design effort; consequently, there could be no evaluation or feedback of results.

Total Systems Adequacy of the Design

Analysis indicates that only a "total systems approach to cultural adaptation" as originally conceived in this organizational design, including both on-reservation and off-reservation activities, would meet the manpower development needs of this tribe. However, it is also evident that more understanding of this basic concept by both tribal political factions and federal government officials concerned with this topic area would be necessary before designs of the type first envisioned in this project would be accepted.

Although it included all of the kinds of design outputs that might reasonably be expected, the reoriented design that finally developed was certainly not adequate to the total system needs implied in the goals of the design effort. It had eliminated the parts of the organizational system that would have made the design adequate--the off-reservation programs. The environmental constraints imposed from several sources had essentially required the designers to shift from a professional to a technician role, where they did not have the authority to develop an adequate design or the collaboration required from the client to implement it.

Case D: Mass-production Factory

Whereas the last case is an example of a design effort that failed in implementation, the present case is one that ultimately succeeded. It therefore provides us with a comparative basis for beginning to make tentative generalizations about factors that contribute to success or failure in the implementation of organizational designs.

The organization known fictitiously as "The Banner Company" is located in a large midwestern city. It is reported to be, in sales dollar volume, one of the larger packaging companies in the United States, producing mostly high-quality multicolor gravure and flexography on a variety of materials such as cellophane, metal foils, plastic films, and papers.*

---

* See Seashore and Bowers, op. cit., pp. 4-5.

This company and its main plant were in a profitably and largely noncompetitive position under founder-managers until after World War II. During the postwar period, it increased in size and complexity of organization. But as time went by it also became apparent that:

> Although the firm continued to grow in its field, not all was entirely well with the Company by 1958. Profit rate had declined; profits from newer products began to be approached and frequently exceeded by losses in some of the older and more competitive lines. Although over-expansion of competition and general business level fluctuations played large parts in these trends, the decline in financial performance was, to some degree, attributable to internal organizational problems.
>
> Some lack of clarity in responsibility definition existed throughout the organization. Frequently, decisions were made by manufacturing which had undesirable effects on sales programs, or sales decisions were made without regard to manufacturing capabilities, or product development decisions were not synchronized with sales and/or manufacturing. Within the manufacturing group there was also an absence of adequate definition of responsibility. There were no regular meetings of linked groups beyond the top staff group, and few ways to coordinate decisions. Considerable frustration existed because of internal and external failures which prevented participation in decisions and even frequently prevented decisions.*

Almost simultaneously with these developments, the manager of the main plant (and a vice president of the company) attended conferences where he had become acquainted with principles of "participative management." Soon thereafter this plant manager arranged a contract with Dr. Rensis Likert of the Survey Research Center, University of Michigan, to investigate ways to introduce participative management techniques to improve the structure of authority and coordination and the functioning of interdepartmental communication and individual motivation in this plant.

---

* Ibid., p. 7.

Thus, what became for this plant manager essentially a program to redesign the structure and functioning of his organization became for several university researchers a field experiment in organizational change techniques. Procedures and findings from the latter point of view have been written up by Stanley E. Seashore and David G. Bowers and published under sponsorship of the Air Force Office of Scientific Research.* Material in this same publication is used here for the purposes of analyzing the activity from the other standpoint--that of an organizational redesign effort.

Inputs to Design Activities

As might be expected, the organizational redesign activities discussed in this case draw most heavily on the social psychological theories and research of the "Michigan school" on "participative management," the roles of "change agents," and related concepts.†

Goal Formulation and Implementation

There is some confusion in the participative management literature on the degree to which group members actually participate in setting goals for an overall organization versus the degree to which they participate in setting goals for their own immediate work group. A full analysis of the theory seems to suggest that group members participate directly in the latter, but not necessarily directly in the former. (The former is usually determined by some elite group--managers, members of a board of directors, owners, etc.)‡ Nevertheless, the theory asserts that various techniques of participative management result in (1) group activities that enhance an experience of personal growth and hence high work motivation among group members and (2) tendencies to set group goals that support and are in harmony with overall organizational goals.

In the Banner plant, the plant manager (the client) had determined that the goal of the redesign effort would be to improve the effectiveness of the structure and functioning of the plant as a whole; the

---

* Ibid.

† The most general summary of the Michigan studies is to be found in Likert, op. cit.

‡ Theorists like Barnard and Selznick have claimed that goal-setting and related definitions of "organizational character" are primary functions of leadership elites; see Chapter VII.

Michigan researchers (the designers or redesigners) acted to implement this goal by conducting seminars and counseling key plant staff personnel in participative management techniques, as well as by observing, analyzing, and measuring the results of changes that could be attributed to the use of these techniques.

Environmental Constraints

During the change implementation effort, the researchers noted the effects of certain conditions outside the Banner Company, including price fluctuations for products, technological innovations, more intensive applications of industrial engineering methods, growth of competing companies, and merger actions. In fact, the Banner Company itself was absorbed by a larger company, causing insecurity internally among both management and production personnel.

Role of the Designer

The report of this effort indicates some confusion about the role of the designer, both in the minds of the members of the client organization and in the minds of the designers themselves. The former grew largely out of the insecurities of staff members with their status in the face of the company merger; the latter reflected a desire on the part of the researchers to avoid playing an active design role, but rather to remain in a more passive researcher-observer role, as is reflected in the following comment:

> Many supervisors and employees, grasping for magical solutions to their complex problems, came increasingly to unrealistic expectations about the pace of the project's work and the certainty of its benefits. At this point, the Center agreed to an early activity designed to introduce a note of calmness and realism, while still advancing the intended work. Hurriedly prepared questionnaires, concerning attitudes toward the firm and the work situation, were administered to all production people, supervisors, and management people during July and early August. This provided data useful in study planning, and more important, provided the occasion for reaffirming the long-time perspective and modest expectations of those responsible for the project. It had the unfortunate effect of giving early and undue prominence to the Center and its representatives, such that from that time on most people and their supervisors perceived these

representatives not as observers but as the source and carriers of the hoped-for changes. It took many months to rebuild the intended role of the Center and the perceptions of it* (emphasis added).

However, that the client (the plant manager) and probably many members of his staff continued to view the researchers in a more active "change agent" role is indicated in comments in his letter to the researchers regarding their report at the end of the program:

> We feel that your report has been presented in a very objective manner. However, for a number of reasons that I will attempt to outline, we feel strongly that the report understates the gains we have realized from the field experiment by your organization.
>
> Many factors external to this study have helped us to turn our critical situation around and achieve some rather major success. However, we deeply believe that without the seminar training and the work by the SRC team that we would not have been in a position to move with these changes as effectively. In our report of 1961 progress and plans for the future which was made to our corporate management, we listed a profit gain of over 7% of sales. We further pointed out that we had been able to increase our volume in the previous 18 months with 65 fewer people (who left the company for usual reasons, such as retirement, at a normal turnover rate). We further reported that our quality was improved as evidenced by reduced returns, our service to customers had improved, as evidenced by many measurements we had established, and that considerable new process improvements were in the offing as a result of the work of all of our people. Our safety record was not only the best we had yet had, but was better than our division total and better than our corporate total on a frequency basis. We closed this report to management by stating: "A significant foundation for much of our progress is the . . . study with the University of Michigan. These efforts continue to bear fruit, with greater people participation, involvement, decision decentralization, and two-way communication. Morale, attitudes, and motivational forces seem to be improving."†

---

* Seashore and Bowers, op. cit., p. 15.

† Ibid., p. 104.

These comments may reflect the common tendency among academic research personnel to try to remain detached from situations that they are studying, but in this situation in actuality, the client's letter and other comments suggest that the researchers had been playing a professional organizational design role--whether they would have acknowledged this or not.

Outputs from Design Activities

The fact that "the designers" in this case had not produced any of the commonly recognized outputs of organizational design work--e.g., goal statements, systems diagrams, organization charts, position descriptions--was probably one of the factors that obscured their role as designers (redesigners) in their own view. Nevertheless, they did produce a variety of stimuli to change organizational structure and functioning. Unlike other design efforts, these stimuli were presented in unwritten form--in the form of suggestions presented at seminars, in individual counseling sessions, and in daily communications. In the more crucial second phase of the change implementation effort, it was reported that one researcher performed the following services:

1. Attending, as observer and "post mortem" meeting analyst, the regular meetings of the manufacturing staff of the several plant superintendents' groups, and of such other regular operating meetings as he could get to and was invited to.

2. Conducting a series of "feedback sessions" for all supervisors, apart from their regular work groups, to discuss the statistical data resulting from analysis of an earlier SRC employee survey in the plant.

3. Conducting a formal course of evening training conferences for supervisors, at about two-week intervals, covering some principles of human behavior related to the program objectives.

4. Meeting individually as requested with various supervisory and staff people who wanted his suggestions about how to apply the program ideas to particular situations.*

---

* Ibid., p. 39.

Implementation of the Design

In contrast to Cases A, B, and C, this case represented almost completely a design implementation effort, extending over three years. In Phase One of this effort (five months), the designer attempted to play more of a passive observer role rather than an active change agent role, but soon found himself getting involved in meetings with employees under the leadership of their regular supervisors, as well as individual and group conversations with employees at various levels in the plant. However, at the end of this period it was noted that "there had not been any radical change in either organizational process or performance (other than a sharp increase in number of meetings) . . ."* Consequently, another designer began to play a more systematic and more active role in Phase Two (about one year) including the four activities mentioned previously under Outputs from Design Activities.

During Phase Three, the last year of effort, the designer withdrew from regular contacts with the plant personnel. Although he continued to have occasional contacts, the main burden of implementation activities was now carried by the plant staff.

Evaluation and Feedback of Results

As indicated in the previous quotation from the client's letter at the termination of the project, the plant management was pleased with the results of the implementation effort and had some data to support this satisfaction. The research report presents data on organizational performance and on before-and-after questionnaire responses to assess the implementation effort, comparing results in several plant departments in which implementation activities were conducted with results from other departments where they were not conducted--an "experimental" and "control group" comparison.

Analysis of the results of this comparison indicated that this implementation effort definitely changed attitudes and related interpersonal interactions in the direction desired. This effort also appeared to affect organizational performance data in the direction expected, although in a somewhat less clear-cut manner.† (This latter finding is not unusual, in that organizational performance in "field situations" generally reflects the influence of a variety of "uncontrolled" variables acting in contradictory ways.)

---

* Ibid., pp. 32-3.

† Ibid., Chapters 9 and 10.

Since the "designers" in this case were associated with a major university, one can assume that the results of this project have found their way back into the fund of knowledge about organizational behavior that staff members of this university are helping to generate.

Total Systems Adequacy of the Design

All the large amount of evidence that is being collected indicates that, in spite of some confusion about certain aspects of the participative management theory of organizational operation, it is generally more effective than most competing theories--even in situations in which standardized products are being produced by standardized methods. It is more effective than competing theories because it results in the best kind of balance between needs for security and for challenge in organizational environments, it encourages the continued growth of individual talents, and it tends to support the capability of organizational entities to be flexible and innovative. Furthermore, this case lends further support to the conclusion that designers acting in a professional role can make active and vital contributions to the implementation of an organizational design or redesign effort--even though they may not clearly recognize the role that they are playing themselves.

We cannot determine precisely why this implementation effort was successful while the implementation in Case C was not. However, we can speculate that one or more of the following considerations may have significantly influenced success in Case D:

1. The environmental constraints may have been less severe.

2. Client understanding and acceptance of the design effort from the beginning may have been stronger.

3. More time was provided for the design and implementation effort (three years versus six months).

4. The designers were permitted to work directly with all levels of personnel in the client organization--not just one management official in the role of a "client representative."

5. Implementation efforts could have been easier because the kind of organization being designed in this case was "technologically congruent"--the materials being processed were essentially standardized and the production methods were also mainly standardized. In other words, the members of the client organization knew essentially what to expect and how to deal with it in prearranged ways. In Case C, on the other hand, the members of the client organization also knew the kind of human beings that they would have to process, but there was no consensus on how this processing would be accomplished. It would certainly call for much individual experimentation and variation in methods on the part of staff members. Thus in Case C, by the nature of the organization, there was a lack of congruence between the degree of standardization of the items to be processed and the methods for processing, which, in turn, may have contributed to difficulties in the design effort.

Hypotheses from the Case Studies

Comparative examination of these four case studies from an organizational design standpoint can suggest many topic areas for further investigation in other cases. However, three of these topic areas for further study seem to be pre-eminent and to subsume many other related topics within each topic area. The three topic areas are concerned, respectively, with the technological nature of the organization to be designed, the degree of mutual understanding about the role of the designer, and the degree of continuity in the design process. These may be stated in the following hypothetical form:

1. Organizations that are "technologically congruent" will be easier to design that those that are not. In the cases examined, A and D were technologically congruent. Case A has materials to be processed and methods for processing that are essentially nonstandardized; Case D is standardized in both respects. In both cases, there was evidence that design efforts were relatively smooth. In contrast, Case B had standardized methods applied to nonstandardized situations. While there were no significant problems in the initial design effort of Case B, it is important to note that the design activities have not yet been carried into the implementation phase; major probjems might be expected to occur in this phase. Finally, we did have some detailed information about the problems that occurred in Case C, where technological incongruity was also present.

2. Situations in which the role that the designer takes is not clearly understood and accepted by the client, the client organization ("covert clients"), and/or the designer are likely to be accompanied by major problems in the design process. Cases C and D were most indicative of problems from this source. It was in Case C that these problems appeared to be most serious, perhaps partly because they were combined with the problems mentioned in (1) above.

3. Situations in which there is a smooth continuity between all phases of the entire design process, from initial inputs to testing and evaluation of the design effort, are more likely to lead to successful design efforts. This implies that all the principal steps in the design process, as indicated in Figure 4 in Chapter VII, should be present, that there should be in all phases an understanding and acceptance of the designer's role as indicated in (2) above, and above all that there should be sufficient time to articulate various aspects of the total design process. Lack of time to do more things was a major hindrance to the design in Case C; and it was also noted that sufficient time had not yet elapsed to implement or evaluate the effectiveness of the design effort in Case B. In all four cases, it was evident that clients do not usually accept new designs or radical redesigns of familar organizational forms quickly. Proposed changes must be "read, marked, learned, and inwardly digested" before they can be fully accepted and successfully implemented. That is why good organizational design takes time.

Chapter IX

PRELIMINARY DESIGN CRITERIA AND TOOLS

The review of major problems confronting modern organizations, the analysis of the organizational design process, and the examination of four cases in terms of components of the organizational design process all suggest certain preliminary criteria and tools that might be useful in future organizational design efforts. By criteria of organizational design, we mean major factors to consider or to take into account in the organizational design process. By tools for organizational design, we mean concepts, analytic approaches, or methods of inquiry that are useful aids in the design process. In short, design criteria refer to the "who" and the "what" in the design process, or its division of labor and content; design tools refer to the "how", or its method.

Design Criteria

In developing criteria for organizational design, we assume that certain prerequisites should be taken into account. These prerequisites include the following:

1. Effectiveness and efficiency. Organizations should be designed as social systems in which maximum effectiveness (accomplishment of organizational purpose) and maximum efficiency (satisfaction of individual needs) are simultaneously sought.*

2. Manipulability. Criteria for organizational design should concentrate on what can be manipulated by managers or designers in efforts to design new organizations or to redesign (change) old organizations.†

---

* Barnard introduced these two concepts and discussed them in detail in The Functions of the Executive.

† In classical experimental terms, variables to be manipulated are referred to as "independent" variables; all other related variables are called "dependent."

3. Parsimony. Economy should be sought in the specification of basic criteria for organizational design, including only those that are necessary (i.e., that describe major variables with major consequences), in terms of present knowledge.

4. Inclusiveness. At the same time, criteria for organizational design should be complete so that major variables or important interactions among variables are not overlooked.

5. Adaptability. Criteria for organizational design should provide for flexibility in design activities, so that these criteria are applicable to a variety of organizational objectives and environmental contexts.

Applying these considerations to the findings reported in previous chapters of this exploratory investigation, we can arrive at the following tentative criteria for organizational design, subject to confirmation in further research. These criteria may be discussed under three general headings--The Role of the Designer, Organizational Variables, and Evaluative Variables.

The Role of the Designer

Organizational design activities can be conducted by (1) line management--which is the traditional way it has been done over thousands of years of recorded history--or by (2) organizational design specialists--a newly emerging professional group--working in some kind of relationship with line managers. Because of the variety of inputs from both theoretical and applied disciplines that are now being brought to bear on the design process, and because of the need for an effective use of these inputs, we would hypothesize that:

1. The skills of organizational design specialists will be drawn on by line managers more and more in the future.

2. Those organizational designs that are most successful will be those that do involve the talents of organizational design specialists in some significant way.

3. Organizational designers that are most useful and most effective will be those who are well grounded in the range of theoretical and applied disciplines that are relevant to the design process (see Chapter VII).

4. Organizational design specialists acting in either an "expert consultant" or a "professional" capacity will be more effective than those in an "artist" or a "technician" role, because the former role patterns involve designers and clients in a closer collaborative relationship (see Figure 5 and Chapter VII).

5. Situations in which the role of the designer is clearly understood and accepted by (a) the client, (b) other significant members of the client organization ("covert clients"), and (c) the designer himself will foster the most effective organizational designs (see Chapter VIII).

6. Situations in which the role of the designer is clear and accepted throughout all phases of the entire design process, from initial inputs to the testing and evaluation of the design effort, will foster the most effective implementation of organizational designs (see Chapter VIII).

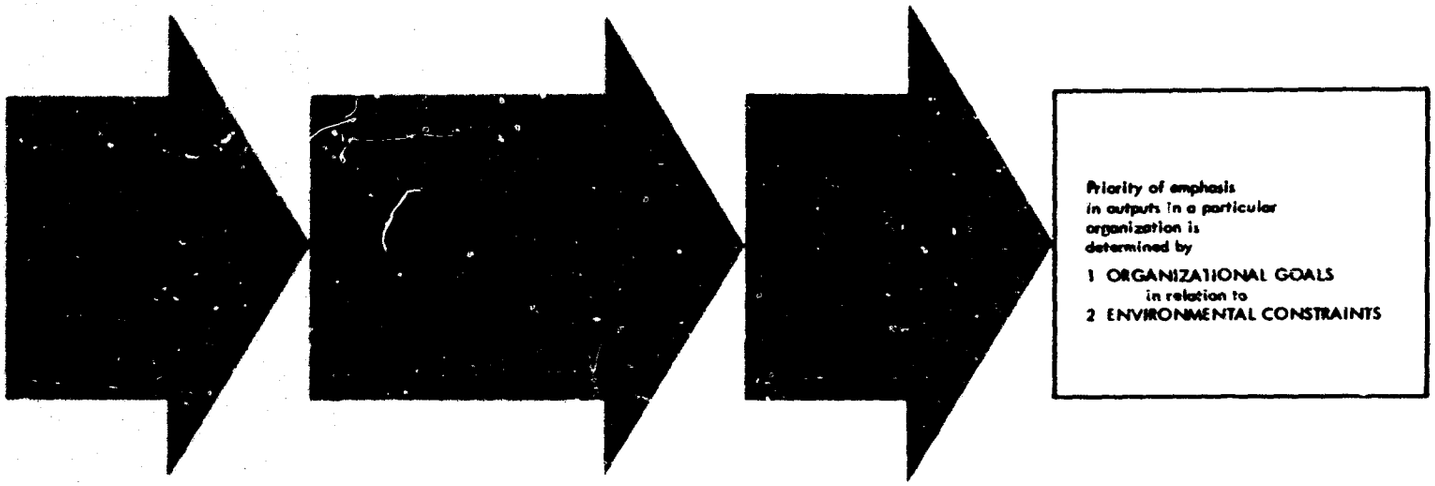
The above hypotheses can be summarized in the form of tentative design criteria--again subject to further research--by indicating that successful organizational designs appear to require the participation of well trained organizational design specialists in a collaborative relationship with management that is clearly recognized and accepted by all parties, and that extends throughout the design process.

Organizational Variables

Criteria for the design of organizations as social systems also need to take into account the way in which principal input and transformation variables are to be manipulated in the organization to be designed to achieve desired outputs effectively and efficiently. As shown in Figure 8, major input variables include people, information, materials, money, and services. Processes related to the acquiring of these inputs--recruitment, information acquisition, purchasing, financing, etc.--must be taken into account in organizational design. Also processes concerned with transforming these inputs into desired outputs must be considered; these include the basic technology of the organization (i.e., the degree to which inputs are standardized and the degree to which their methods of handling are standardized) and the pattern of structure and function of the organization, including its hierarchy of authority, division of labor, patterns of formal and informal communications, and layout of physical facilities. In turn, all of these considerations must be determined in terms of (1) the operational and maintenance goals of the

Figure 8

MAJOR VARIABLES IN AN ORGANIZATIONAL SYSTEM



SOURCE: Author.

organization and (2) major environmental constraints. And finally, an organization that is not only effective in accomplishing its goals, but is also efficient in the degree to which the needs of its members or employees are met, must provide for meeting these needs in its basic design.

In relation to all these considerations, we would hypothesize that organizational designs (or redesigns) that are most effective are:

1. Those designs that provide for a specified function (in the hands of an individual or a unit) to assure the acquisition of individuals with the talent necessary for the success of the organization and to assure the maintenance and development of this talent within the organizational context--i.e., support in the structure of the organization for the proper utilization and growth of both actual and potential talent (see the discussion of manpower utilization and development functions in Chapter III).

2. Those designs that provide for a specified function (in the hands of an individual or a unit) that is concerned with innovation in relation to the future activities of the organization (e.g., long range planning, technological forecasting, basic research--see Chapter VI).

3. Those designs that provide for a form of technology that is most appropriate to the goals and the environmental constraints of the organization; in other words, those designs that properly relate (a) the degree of standardization in materials to be processed in the organization and (b) the degree of standardization in methods of processing to the goals of the organization (the nature of the major output desired) and the main environmental constraints (the complex of human, economic, political, legal, sociocultural, and technological forces that impinge on the organization--see Figures 2 and 4 and Chapter VII).

4. Those designs that provide for an organizational structure and pattern of functioning, including a hierarchy of authority, division of labor, pattern of formal and informal communications, and layout of facilities, that are appropriately related to organizational goals, form of technology, and environmental constraints (see Chapters VI and VII).

As in the case of the hypotheses regarding the role of the designer, these hypotheses regarding the main organizational variables could also be translated into tentative design criteria, subject to verification and refinement in further research.

Evaluative Variables

Verification and refinement of the previously mentioned principles of organizational design require refinement in the measurement of organizational effectiveness and efficiency. We need to know what kinds of variables to examine to determine whether organizational designs have been effective. There is much evidence that measures of financial profit, organizational productivity, rates of waste or scrap, job satisfaction and dissatisfaction, employee turnover, etc., are all the result of complex influences and are therefore somewhat inadequate indicators of overall organizational effectiveness and/or efficiency. Combinations of measures are sometimes used, but there is no agreement as to the weight that should be given to different measures in particular instances. There is undoubtedly a strong need for more work on the development of accurate, meaningful, and commonly acceptable measures of organizational performance. And we know that the effectiveness of organizational designs must ultimately rest on measures of the effectiveness of the organizations designed.

Pending the development of such refined measures of organizational effectiveness, however, we might suggest the following kinds of indicators, or sources of information, regarding the effectiveness of organizational design activities in terms of the role relationship and organizational variables criteria mentioned above:

1. The degree to which documentary outputs of the organizational design process--goal statements, systems diagrams, organization charts, position descriptions, policy manuals, physical facilities designs, etc.--reflect these criteria.

2. The degree to which interview comments of designers, clients, and members of the client organization reflect these criteria.

3. The degree to which any other data on productivity, profit and loss, attitude and opinion surveys, etc., reflect these criteria.

These are the kinds of data that will be sought in case studies of ongoing organizational design activities in the further work in this project.

Design Tools

As a part of this exploratory investigation, certain concepts, analytic approaches, or methods of inquiry that could be useful aids to organizational designers have also been developed in a preliminary form. It is expected that these design tools will be refined in applications in the further work in this project. Here they may be mentioned briefly as:

1. Organizational design process analysis--a method for analyzing specific organizational design activities in terms of interrelated activities that form a total design process (see Chapters VII and VIII and Figure 4).

2. Organizational design role analysis--a method for describing the role of an organizational designer vis-a-vis a client (see Chapter VII and Figure 5).

3. Technological structure-function analysis--a method for analyzing the relationships between the basic technology of an organization and its structure and functioning, based on Perrow's theory (see Chapter VI and Figures 2 and 7).

4. Adaptation mechanisms analysis--a method for identifying and analyzing the ways in which individuals adapt to organizations and organizations adapt to individuals, based on previous work reported in Vollmer, Adaptations of Scientists and Organizations (see Chapter III).

5. Manpower development analysis--a method for measuring and analyzing the extent to which organizations overutilize or underutilize actual or potential talent (see Chapters IV and V).

6. Facility/function Analysis--a method for designing facilities in terms of organizational and functional considerations, based on Tennant's research (see Chapter VII).

BIBLIOGRAPHY

Abelson, P. H., "Mainland China: An Emerging Power," Science, Vol. 157, No. 3787 (July 28, 1967)

Alford L. P., Principles of Industrial Management (New York: Ronald Press, 1940)

Allen, L. A., Management and Organization (New York: McGraw-Hill, 1958)

_____, Organization of Staff Functions (New York: National Industrial Conference Board, "Studies in Personnel Policy, No. 165," 1958)

_____, Preparing the Company Organization Manual (New York: National Industrial Conference Board, "Studies in Personnel Policy, No. 157," 1957)

Allison, D., "Engineer Renewal," International Science and Technology, No. 30 (June 1964), p. 49

Allport, G. W., "The Trend in Motivational Theory," American Journal of Orthopsychiatry, Vol. 23 (January 1953), pp. 107-119

Ansoff, H. I., Corporate Strategy (New York: McGraw-Hill, 1965)

Argyris, C., Integrating the Individual and the Organization (New York: Wiley, 1964)

_____, Personality and Organization (New York: Harper, 1957)

Banfield, E. C., and J. Q. Wilson, City Politics (Cambridge, Mass.: Harvard University Press, 1963)

Barker, R., T. Dembo, and K. Lewin, "Frustration and Regression," University of Iowa Studies in Child Welfare, Vol. 18, No. 1 (1941)

Barnard, C., The Functions of the Executive (Cambridge, Mass.: Harvard University Press, 1938)

Bendix, R., Work and Authority in Industry (New York: Wiley, 1956)

Bennet, C. L., Defining the Manager's Job (New York: American Management Association, 1958)

Bennis, W. G., Changing Organizations (New York: McGraw-Hill, 1966)

Bennis, W. G., K. D. Benne, and R. Chin, eds., The Planning of Change (New York: Holt, Rinehart and Winston, 1961)

Blau, P. M., and W R. Scott, Formal Organizations (San Francisco: Chandler, 1962)

Bowers, R. V., ed., Studies on Behavior in Organizations (Athens, Ga.: University of Georgia Press, 1966)

Branch, M. C., The Corporate Planning Process (New York: American Management Association, 1962)

Brimmer, A. F., "The Negro in the National Economy," in J. P. Davis, ed., The American Negro Reference Book (Englewood Cliffs, N.J.: Prentice-Hall, 1966)

Bruner, J., "The Act of Discovery," Harvard Educational Review, Vol. 31 (winter 1961) pp. 26-28

Burns, T., and G. M. Stalker, The Management of Innovation (London: Tavistock, 1961)

Cassell, F. H., "Jobs for the Hard-to-Employ in Private Enterprise," in F. H. Harbison and J. D. Mooney, eds., Critical Issues in Employment Policy (Princeton, N.J., Princeton University, Industrial Relations Section, 1966)

Charlesworth, J. C., Mathematics and the Social Sciences (Philadelphia: American Academy of Political and Social Science, 1963)

Christian, R. W., "Personal Obsolescence," Factory, Vol. 122 (October 1964)

Clark, B., Adult Education in Transition (Berkeley and Los Angeles: University of California Press, 1956)

Cleland, D. I., "Organizational Dynamics of Project Management," IEEE Transactions on Engineering Management, Vol. EM-13 (December 1966), pp. 201-205

Cohen, K. J., and R. M. Cyert, "Simulation of Organizational Behavior," in J. G. March, ed., Handbook of Organizations (Chicago: Rand McNally, 1965)

Committee on Utilization of Scientific and Engineering Manpower, Toward Better Utilization of Scientific and Engineering Talent (Washington, D.C.: National Academy of Sciences, 1964)

Cooley, C. H., Social Organization (New York: Charles Scribners, 1929)

Cressey, D. R., The Prison: Studies in Institutional Organization and Change (New York: Holt, Rinehart, and Winston, 1961)

Dale, E., The Great Organizers (New York: McGraw-Hill, 1960)

Davis, J. P., ed., The American Negro Reference Book (Englewood Cliffs, N.J.: Prentice-Hall, 1966)

Drucker, P. F., The Practice of Management (New York: Harper, 1954)

Dubin, R., ed., Human Relations in Administration (Englewood Cliffs, N.J.: Prentice-Hall, 1961)

Durkheim, E., The Division of Labor in Society (Glencoe, Ill.: Free Press, 1933)

Dysinger, D. W., Motivational Factors Affecting Civilian Army Research and Development Personnel (Pittsburgh, Pa.: American Institutes for Research, 1965)

Engineering Manpower Commission of Engineers Joint Council, Demand for Engineers (New York: E.M.C. of E.J.C , 1962)

Etzioni, A., A Comparative Analysis of Complex Organizations (New York: Free Press, 1961)

_____, ed., Complex Organizations: A Sociological Reader (New York: Holt, Rinehart and Winston, 1954)

Evan, W. M., "Organization Man and Due Process of Law," American Sociological Review, Vol. 26 (1961), pp. 540-547

Fayol, H., General and Industrial Management (London: Pitman, 1949)

Federal Woman's Award Study Group on Careers for Women, Progress Report to the President (Washington, D.C., March 3, 1967)

Ferdinand, T. N., "On the Obsolescence of Scientists and Engineers," American Scientist, Vol. 54 (1966), pp. 46-56

Fisk, G., ed., The Psychology of Management Decision (Lund, Sweden: Gleerup, 1967)

Foley, E. P., "The Negro Businessman," Daedalus, Vol. 95 (Winter 1966) pp. 107-144

Frankl, V. E., "Basic Concepts of Logotherapy," Journal of Existential Psychiatry, Vol. 3 (1962), pp. 113-114

_____, From Death Camp to Existentialism (Boston: Deacon Press, 1959)

Freud, S., The Basic Writings of Sigmund Freud, A. A. Brill, trans. and ed. (New York: Random House Modern Library, 1938)

Fromm, E., The Art of Loving (New York: Harper, 1956)

Gardner, J. W., Self-Renewal (New York: Harper and Row, 1964)

Garfinkle, S. H., et. al., "Work Life Expectancy and Training Needs of Women," Manpower Report, No. 12 (May 1967), pp. 1-10

Gellhorn, W., Ombudsman and Others (Cambridge, Mass.: Harvard University Press, 1966)

Ginzberg, E., and D. L. Hiestand, "Employment Patterns of Negro Men and Women," The American Negro Reference Book (Englewood Cliffs, N.J.: Prentice Hall, 1966)

Goffman, E., Asylums (Garden City, N.Y.: Asylums, 1961)

Goldman, J. E., "Basic Research in Industry," International Science and Technology, Vol. 7 (December 1964), p. 44

Gordon, R. A., Business Leadership in the Large Corporation (Berkeley and Los Angeles: University of California Press, 1961)

Gouldner, A. W., "Organizational Analysis," in R. K. Merton, L. Broom, and L. S. Cottrell, Jr., eds., Sociology Today (New York: Basic Books, 1959)

Greiner, L. E., "Patterns of Organization Change," Harvard Business Review, Vol. 43, No. 3 (May/June 1967), pp. 119-130

Gulick, L., and L. Urwick, Papers on the Science of Administration (New York: Columbia University, Institute of Public Administration, 1937)

Haberstroh, C. J., "Organization Design and Systems Analysis," in J. G. March, ed., Handbook of Organizations (Chicago: Rand McNally, 1965)

Hagstrom, W. O., The Scientific Community (New York: Basic Books, 1965

Haire, M., "The Concept of Power and the Concept of Man," in G. B. Strother, ed., Social Science Approaches to Business Behavior (Homewood, Ill.: Dorsey-Irwin Press, 1962)

_____, ed., Modern Organization Theory (New York: Wiley, 1959)

_____, Psychology in Management (New York: McGraw-Hill, 1956)

Harbison, F. H., and J. D. Mooney, eds., Critical Issues in Employment Policy (Princeton, N.J.: Princeton University, Industrial Relations Section, May 12-13, 1966)

Hayes, G., The Industry-Government Aerospace Relationship (Menlo Park, Calif.: Stanford Research Institute, 1963)

Henry, W. E., "Conflict, Age, and the Executive," Business Topics, Vol. 9, No. 2 (Spring 1961), pp. 15-25

Herzberg, F., et. al., The Motivation To Work (New York: Wiley, 1959)

Homans, G., The Human Group (New York: Harcourt Brace, 1950)

Industrial Research Institute, "Continued Development of Technical Personnel--Prevention of Obsolescence," Research Management, Vol. 8 (1965)

Jacques, E., The Changing Culture of a Factory (London: Tavistock, 1951)

Janger, A. R., "Anatomy of the Project Organization," Business Management Record (November 1963), pp. 12-18

_____, "Charting Authority Relationships," The Conference Board Record, Vol. I (December 1964), pp. 8-13

_____, "Making Titles Meaningful, " Business Management Record (August 1963), pp. 43-49

_____, "What's in a Position Guide," Management Record, Vol. 23 (1961), pp. 28-38

Janowitz, M., The New Military (New York: Russell Sage Foundation, 1964)

_____, The Professional Soldier (Glencoe, Ill.: Free Press, 1960)

_____, Sociology and the Military Establishment (New York: Russell Sage Foundation, 1959)

Joint Engineering Management Conference, Managing Engineering Manpower (New York: American Society of Mechanical Engineers, 1967)

Katz, D., and R. L. Kahn, The Social Psychology of Organizations (New York: Wiley, 1966)

Kilpatrick, F. P., M. C. Cummings, Jr., and M. K. Jennings, Source Book of a Study of Occupational Values and the Image of the Federal Service (Washirgton, D.C.: The Brookings Institution, 1964)

Kornhauser, A., R. Dubin, and A. M. Ross, eds., Industrial Conflict (New York: McGraw-Hill, 1954)

Kornhauser, W., Scientists in Industry: Conflict and Adaptation (Berkeley and Los Angeles: University of California Press, 1962)

Kroeber, A. L., Anthropology Today (Chicago: University of Chicago Press, 1953)

Leamer, F. D., "How a Company Minimizes Turnover and Maximizes Efficiency as Applied to Technical Personnel," Managing Engineering Manpower (New York: American Society of Mechanical Engineers, 1967)

Leavitt, H. J., "Applied Organizational Change in Industry: Structural, Technological, and Humanistic Approaches," in J. G. March, ed., Handbook of Organizations (Chicago: Rand McNally, 1965)

_____, Managerial Psychology (Chicago: University of Chicago Press, 1958)

_____, The Social Science of Organizations (Englewood Cliffs, N.J.: Prentice-Hall, 1963)

Lebold, W. K., R. Perruci, and W. Howland, "The Engineer in Industry and Government," Journal of Engineering Education, Vol. 56 (1966)

Lester, R. A., "The Economics of Manpower Planning and Operations," Manpower Planning in a Free Society (Princeton, N.J.: Princeton University Press, 1966)

Levi-Strauss, C., "Social Structure," in A. L. Kroeber, Anthropology Today (Chicago: University of Chicago Press, 1953)

Lewin, K., Resolving Social Conflicts (New York: Harper, 1948)

Lewis, H., "Culture, Class and Family Life among Low-Income Urban Negroes," in A. M. Ross and H. Hill, eds., Employment, Race and Poverty (New York: Harcourt, 1967)

Likert, R., New Patterns of Management (New York: McGraw-Hill, 1961)

Lippitt, R., and R. K. White, "An Experimental Study of Leadership and Group Life," in T. M. Newcomb and E. L. Hartley, eds., Readings in Social Psychology (New York: Henry Holt & Co., 1947)

Lipset, S. M., M. A. Trow, and J. S. Coleman, Union Democracy (Glencoe, Ill.: Free Press, 1956)

Loomba, R. P., A Study of the Re-employment and Unemployment Experiences of Scientists and Engineers Laid Off from 62 Aerospace and Electronics Firms in the San Francisco Bay Area during 1963-65 (San Jose, Calif.: San Jose State College, Center for Interdisciplinary Studies, 1967)

Malinowski, B., Magic, Science, and Religion and Other Essays (Glencoe, Ill.: Free Press, 1948)

March, J. G., ed., Handbook of Organizations (Chicago: Rand McNally, 1965)

March, J. G., and H. A. Simon, Organizations (New York: Wiley, 1958)

Marschak, T. A., "Economic Theories of Organizations," in J. G. March, ed., Handbook of Organizations (Chicago: Rand McNally, 1965)

Marsh, J. E., M. J. Giorgia, and J. M. Madden, A Job Analysis of a Complex Utilization Field: The R&D Management Office (Lackland AFB, Texas: Personnel Research Laboratory, 1965)

Marshall, W. R., Jr., "Educators Get Obsolete Too," Chemical Engineering Progress, Vol. 59 (October 1963)

Maslow, A. H., Motivation and Personality (New York: Harper, 1954)

Mayo, E., The Social Problems of an Industrial Civilization (London: Routledge and Kegan Paul, 1949)

McDougall, W., Introduction to Social Psychology (London: Methuen, 1908)

McFarland, D. E., "Organization Design, Personnel Administration, and Administrative Expectations" (a paper delivered at the 14th International Meeting of the Institute of Management Sciences, Mexico City, Mexico, August 26, 1967)

McGregor, D., The Human Side of Enterprise (New York: McGraw-Hill, 1960)

McIlvaine, W. D., The Professional Technical Employee: What Factors Affect His Continued Growth (Los Angeles: University of California at Los Angeles, Department of Engineering, 1966)

McMillion, S. A., and B. F. Osbahr, "How Do Engineers Keep Up-To-Date," Electronic Industries, Vol. 22 (May 1963), p.80

Meltzer, L., "Scientific Productivity in Organizational Settings," Journal of Social Issues, Vol. 12 (1956), pp. 32-40

Merton, R. K., Social Theory and Social Structure (Glencoe, Ill.: Free Press, 1949)

Merton, R. K., L. Broom, and L. S. Cottrell, Jr., eds., Sociology Today (New York: Basic Books, 1959)

Meyer, H. H., and S. Q. Cuomo, Who Leaves? A Study of Background Characteristics of Engineers Associated with Turnover (New York: General Electric Company, Behavioral Research Service, 1962)

Middleton, C. J., "How To Set Up a Project Organization," Harvard Business Review, Vol. 45, No. 2 (March/April 1967), pp. 73-82

Morton, J. A., "From Research to Technology," International Science and Technology (May 1964), pp. 88-90

Moynihan, D. P., "Employment, Income, and the Ordeal of the Negro Family," Daedalus, Vol. 94 (Fall 1965), pp. 745-770

Myers, S., "Industrial Innovations and the Utilization of Research Output," in Twentieth National Conference on the Administration of Research (Denver, Colo.: Denver Research Institute, 1966)

National Science Foundation, Profiles of Manpower in Science and Technology (Washington, D.C.: NSF 63-23, 1963)

_____, Scientific and Technical Personnel in Industry, 1961 (Washington, D.C.: NSF 63-32, 1963)

_____, Scientists, Engineers, and Technicians in the 1960's (Washington, D.C.: NSF 63-34, 1963)

Neal, M., "Technical Women," International Science and Technology, No. 69 (September 1967), pp. 13-20

Newcomb, T. M., and E. L. Hartley, eds., Readings in Social Psychology (New York: Henry Holt & Co., 1947)

Opinion Research Corporation, The Conflict Between the Scientific Mind and the Management Mind (Princeton, N.J.: Opinion Research Corp., 1959)

Pareto, V., The Mind and Society (New York: Harcourt Brace, 1935)

Park, R. E., and E. W. Burgess, Introduction to the Science of Sociology (Chicago: University of Chicago Press, 1924)

Parsons, T., The Social System (Glencoe, Ill.: Free Press, 1951)

Parsons, T., and E. A. Shils, eds., Toward a General Theory of Action (Cambridge, Mass.: Harvard University Press, 1954)

Pelz, D. C., "Creative Tensions in the Research and Development Climate," Science, Vol. 157 (1967), pp. 160-165

Pelz, D. C., and F. M. Andrews, Scientists in Organizations: Productive Climates for Research and Development (New York: Wiley, 1966)

Perrow, C., "A Framework for the Comparative Analysis of Organization," American Sociological Review, Vol. 32 (April 1967), pp. 194-208

_____, "Hospitals: Technology, Structure, and Goals," in J. G. March, ed., Handbook of Organizations (Chicago: Rand McNally, 1965)

Peters, D. R., "Working Paper," Notes on Career Growth in NASA: Patterning of Interview Responses (Cambridge, Mass.: Massachusetts Institute of Technology, School of Industrial Management, 1963)

Pfiffner, J. M., and F. P. Sherwood, Administrative Organization (Englewood Cliffs, N.J.: Prentice-Hall, 1960)

Phelps, O. W., Discipline and Discharge in the Unionized Firm (Berkeley and Los Angeles: University of California Press, 1959)

Popper, H., "What You Should Know About Women Engineers," Chemical Engineering, Vol. 74 (September 11, 1967), pp. 165-172

Princeton Creative Research, Inc., "Attitudes on Education," Machine Design, Vol. 36, No. 17 (July 16, 1964), pp. 124-127

_____, "Engineers Talk About Obsolescence," Machine Design, Vol. 36, No. 15 (June 18, 1964), pp. 148-151

_____, "Who Pays for Technical Retooling," Machine Design, Vol. 36, No. 16 (July 2, 1964), pp. 92-95

The Professional Engineers Conference Board for Industry, Career Satisfactions of Professional Engineers in Industry (Washington, D.C.: 1960)

_____, Career Satisfactions of Professional Engineers in Industry (Washington, D.C.: 1962)

Radcliff-Brown, A. R., "On the Concept of Function in Social Science," American Anthropologist, Vol. 37 (1935), pp. 394-402

Rainwater, L., "Crucible of Identity: The Negro Lower-Class Family," Daedalus, Vol. 95 (Winter 1966), pp. 172-216

Riley, M. W., et. al., Sociological Studies in Scale Analysis (New Brunswick, N.J.: Rutgers University Press, 1954)

Rittenhouse, C., The Transferability and Re-training of Engineers (Menlo Park, Calif.: a Stanford Research Institute report to the U.S. Arms Control and Disarmament Agency, 1967)

Rome, B. K., and S. C. Rome, "Leviathan: an Experimental Study of Large Organizations with the Aid of Computers," in R. V. Bowers, Studies on Behavior in Organizations (Athens, Ga.: University of Georgia Press, 1966)

Roney, J. G., Jr., Report on First Conference on Occupational Obsolescence (Menlo Park, Calif., Stanford Research Institute, 1966)

Ross, A. M., and H. Hill, eds., Employment, Race and Poverty (New York: Harcourt, 1967)

Rossi, A. S., "Equality Between the Sexes: An Immodest Proposal," Daedalus, Vol. 93 (Spring 1964), pp. 607-652

Rushing, W. A., "The Effects of Industry Size and Division of Labor on Administration," Administrative Science Quarterly, Vol. 12 (1967), pp. 271-295

Saben, S., "Work Experiences of the Population in 1963," Monthly Labor Review, Vol. 88 (January 1965), pp. 8-16 and A1-23

Scheff, T., Being Mentally Ill (Chicago: Aldine, 1966)

Schein, E. H., Organizational Psychology (Englewood Cliffs, N.J.: Prentice-Hall, 1965)

Schon, D. A., Technology and Change (New York: Delecorte Press, 1967)

Schwartz, M. M., E. Jenusaitis, and H. Stark, "Motivational Factors among Supervisors in the Utility Industry," Personnel Psychology, Vol. 16 (Spring 1963), pp. 45-53

Seashore, S. E., and D. G. Bowers, Changing the Structure and Functioning of an Organization: Report of a Field Experiment (Ann Arbor, Mich.: University of Michigan, Survey Research Center, 1963)

Seifert, W. W., "The Prevention and Cure of Obsolescence in Scientific and Technical Personnel," Research Management, Vol. 7 (1964)

Selznick, P., Leadership in Administration (Evanston, Ill.: Row Peterson, 1957)

_____, The Organizational Weapon (New York: McGraw-Hill, 1952)

_____, TVA and the Grassroots (Berkeley and Los Angeles: University of California Press, 1949)

Selznick, P., and H. M. Vollmer, "Rule of Law in Industry: Seniority Rights," Industrial Relations, Vol. 1 (1962), pp. 97-116.

Shapero, A., "Diffusion of Innovations Resulting from Research: Implications for Research Program Management," in M. Yovits, et. al., Research Program Effectiveness (New York: Gordon and Breach, 1966)

Shapero, A., and H. M. Vollmer, "Technical Profile of the Aerospace Industry," Appendix H, in G. Hayes, The Industry-Government Aerospace Relationship (Menlo Park, Calif.: Stanford Research Institute, 1963)

Shapero, A., R. P. Howell, and J. R. Tombaugh, The Structure and Dynamics of the Defense R&D Industry: The Los Angeles and Boston Complexes (Menlo Park, Calif.: Stanford Research Institute, "R&D Studies Series," 1965)

Shepard, H., "Creativity in R&D Teams," Research and Engineering (October 1956), pp. 10-13

Shepard, H. A., "Changing Interpersonal and Intergroup Relationships in Organizations," in J. G. March, ed., Handbook of Organizations (Chicago: Rand McNally, 1965)

Shull, F. A., Matrix Structure and Project Authority for Optimizing Organizational Capacity (Carbondale, Ill.: Southern Illinois University, Business Research Bureau, 1965)

Silver, I., "The Corporate Ombudsman," Harvard Business Review, Vol. 45 (May/June 1967), pp. 77-87

Simon, H. A., Administrative Behavior (New York: MacMillan, 1954)

Smith, J. C., "Credit-free College Courses: an Impending Explosion," Chemical Engineering, Vol. 74 (April 24, 1967), p. 140

Sofer, C., The Organization from Within (London: Tavistock, 1961)

Soskin, W. F., "Riots, Ghettos, and the 'Negro Revolt,'" in A. M. Ross and H. Hill, eds., Employment, Race and Poverty (New York: Harcourt, 1967)

Staiger, J. G., "What Cannot Be Decentralized," Management Record, Vol. 25 (1963), pp. 19-21

Starbuck, W. H., "Mathematics and Organization Theory," in J. G. March, ed., Handbook of Organizations (Chicago: Rand McNally, 1965)

Stieglitz, H., Corporate Organization Structures (New York: National Industrial Conference Board, "Studies in Personnel Policy, No. 183," 1961)

_____, "Staff-Staff Relationships," Management Record, Vol. 24 (1962) pp. 2-13

Stinchcombe, A. L. "On the Use of Matrix Algebra in the Analysis of Formal Organization," in A. Etzioni, ed., Complex Organizations: a Sociological Reader (New York: Holt, Rinehart and Winston, 1954)

Strauss, A. L., and L. Rainwater, The Professional Scientist: A Study of American Chemists (Chicago: Aldine, 1962)

Strother, G. B., Social Science Approaches to Business Behavior (Homewood, Ill.: Dorsey-Irwin Press, 1962)

Tannenbaum, R. I., et. al., Leadership and Organization (New York: McGraw-Hill, 1961)

Taylor, F. W., The Principles of Scientific Management (New York: Harper, 1942)

Tennant, W. L., "Developing Design Criteria for Research Facilities," Twentieth National Conference on the Administration of Research (Denver, Colo.: Denver Research Institute, 1967), pp. 59-66

Thomas, W. I., The Polish Peasant in Europe and America (New York: Knopf, 1918-21)

_____, The Unadjusted Girl (Boston: Little, Brown & Co., 1923)

Thompson, J. D., ed., Approaches to Organizational Design (Pittsburgh, Pa.: University of Pittsburgh Press, 1966)

_____, Comparative Studies in Administration (Pittsburgh, Pa.: University of Pittsburgh Press, 1959)

Thompson, S., How Companies Plan (New York: American Management Association, "AMA Research Study 54," 1962)

Thompson, V. A., Modern Organization (New York: Knopf, 1961)

United States Civil Service Commission, Federal Workforce Outlook (Washington, D.C.: USCSC, 1965)

U.S. Department of Labor, Manpower Report of the President and Report on Manpower Requirements, Resources, Utilization, and Training (Washington, D.C.: U.S. Department of Labor, April 1967)

_____, Women's Bureau, 1965 Handbook on Women Workers, "Bulletin No. 290" (Washington, D.C.: Government Printing Office, 1965)

_____, Trends in Educational Attainment of Women (Washington, D.C.: Government Printing Office, June 1967)

Vollmer, H. M., Adaptations of Scientists and Organizations (publication forthcoming)

_____, Applications of the Behavioral Sciences to Research Management: an Initial Study in the Office of Aerospace Research (Menlo Park, Calif.: Stanford Research Institute, "R&D Studies Series," 1964)

_____, Employee Rights and the Employment Relationship (Berkeley and Los Angeles: University of California Press, 1960)

_____, "Evaluating Two Aspects of Quality in Research Program Effectiveness," in M. Yovits, et. al., eds., Research Program Effectiveness (New York: Gordon and Breach, 1966)

_____, "Is Turnover a Good Thing?" (a luncheon address given at the 15th Annual Joint Engineering Management Conference, October 9-10, 1967)

Vollmer, H. M., "Organizational Socialization among Scientists," (a paper given at the Annual Meeting of the American Sociological Association, San Francisco, California, September 28-31, 1967)

_____, Structural-Functional Analysis as a Method," in R. V. Bowers, ed., Studies on Behavior in Organizations (Athens, Ga.: University of Georgia Press, 1966)

_____, "Toward a 'Two-decision' Theory of Organizational Conflict and Commitment" (a paper given at the College on Management Psychology of the Institute of Management Sciences, Monterey, California, April 16-18, 1967)

_____, Work Activities and Attitudes of Scientists and Research Managers: Data from a National Survey (Menlo Park, Calif.: Stanford Research Institute, "R&D Studies Series," 1964)

_____, ed., The Fundamental Research Activity in a Technology-Dependent Organization (Washington, D.C.: Air Force Office of Scientific Research, 1965)

Vollmer, H. M., and D. L. Mills, eds., Professionalization (Englewood Cliffs, N.J.: Prentice-Hall, 1966)

Vollmer, H. M., and P. J. McGillivray, "Personnel Offices and the Institutionalization of Employee Rights," Pacific Sociological Review, Vol. 3 (Spring 1960), pp. 29-34

Vroom, V., Work and Motivation (New York: Harper and Row, 1959)

Weber, M., From Max Weber: Essays in Sociology (New York: Oxford University Press, 1946)

_____, The Theory of Social and Economic Organization, trans. by A. M. Henderson and T. Parson (Glencoe, Ill.: Free Press, 1947)

Weidenbaum, M. L., and A. B. Rozet, Potential Industrial Adjustments to Shifts in Defense Spending: an Analysis of a Reduction in Strategic Programs (Menlo Park, Calif.: a Stanford Research Institute report to the Department of Defense, Office of the Director of Defense Research and Engineering, 1963)

Whyte, W. F., Human Relations in the Restaurant Industry (New York: McGraw-Hill, 1948)

_____, Men at Work (Homewood, Ill.: Irwin-Dorsey, 1961)

Wilson, J. Q., "Innovation in Organization: Notes toward a Theory," in J. D. Thompson, ed., Approaches to Organizational Design (Pittsburgh, Pa.: University of Pittsburgh Press, 1966)

Wolf, W., "Wider Horizons in Psychotherapy," American Journal of Psychotherapy, Vol. 16 (January 1962), pp. 124-149

Wolfe, J. K., "Keeping Up to Date--Incareer Training in the U.S.A.," Electronics and Power, Vol. 11 (August 1965), p. 260

Yovits, M., et. al., Research Program Effectiveness (New York: Gordon and Breach, 1966)

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
Stanford Research Institute
Technology Management Programs
Menlo Park, California 94025

2a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b. GROUP

3. REPORT TITLE
ORGANIZATIONAL DESIGN - AN EXPLORATORY STUDY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)
Howard M. Vollmer

6. REPORT DATE
December, 1967

7a. TOTAL NO. OF PAGES
176

7b. NO. OF REFS
216

8a. CONTRACT OR GRANT NO. F44620-67-C-0039

b. PROJECT NO. 9779-02

c. 61445014

d. 681313

9a. ORIGINATOR'S REPORT NUMBER(S)
MU-6329

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
AFOSR 67-2450

10. DISTRIBUTION STATEMENT
1. Distribution of this document is unlimited.

11. SUPPLEMENTARY NOTES
TECH, OTHER

12. SPONSORING MILITARY ACTIVITY
Air Force Office of Scientific Research
1400 Wilson Boulevard (SRLB)
Arlington, Virginia 22209

13. ABSTRACT

This is a Phase I report of a three-year study to develop research-based criteria for the design of new forms of organization or the planned change of existing organizations. The objective of Phase I is to specify preliminary design criteria based upon analysis of organizational theory and prior experiences in organizational design. Relevant literature is reviewed; data are used from a previous five-year study of scientists and organizations; and four organizational design case studies are analyzed -- (a) fundamental research organizations, (b) emergency public services, (c) a manpower development program, and (d) a mass-production factory. Preliminary design criteria relating to (1) the role of the designer, (2) major organizational variables, and (3) evaluative indicators, along with analytic tools, are indicated.

DD FORM 1 NOV 68 1473

UNCLASSIFIED
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Organizational behavior						
Organizational theory						
Organizational design						